H/D isotope effects in high temperature proton conductors

The atomic mass ratio of ca. 2 between deuterium and hydrogen is the highest for any pair of stable isotopes and results in significant and measurable H/D isotope effects in high temperature proton conductors containing these species. This paper discusses H/D isotope effects manifested in O-H/O-D vibration frequencies, the mobility of H+/D+ carriers, the kinetics of the electrochemical oxidation of H2/D2, the solubilities of H2O/D2O and, finally, the spontaneous electromotive force that appears across H2/D2 cells with proton conducting electrolytes. Comparable work on tritium-exchanged materials is also discussed. The results highlight the usefulness of isotope effects in the study of high temperature proton conductors.

The significance of the initiation process parameters and reactor design for maximizing the efficiency of microbial fuel cells

Microbial fuel cells (MFCs) can be used for electricity generation via bioconversion of wastewater and organic waste substrates. MFCs also hold potential for production of certain chemicals, such as H2 and H2O2. The studies of electricity generation in MFCs have mainly focused on the microbial community formation, substrate effect on the anode reaction, and the cathode’s catalytic properties. To improve the performance of MFCs, the initiation process requires more investigation because of its significant effect on the anodic biofilm formation. This review explores the factors which affect the initiation process, including inoculum, substrate, and reactor configuration. The key messages are that optimal performance of MFCs for electricity production requires (1) understanding of the electrogenic bacterial biofilm formation, (2) proper substrates at the initiation stage, (3) focus on operational conditions affecting initial biofilm formation, and (4) attention to the reactor configuration.
Electric power generation by a submersible microbial fuel cell equipped with a membrane electrode assembly

Membrane electrode assemblies (MEAs) were incorporated into the cathode chamber of a submersible microbial fuel cell (SMFC). A close contact of the electrodes could produce high power output from SMFC in which anode and cathode electrodes were connected in parallel. In polarization test, the maximum power density was 631mW/m² at current density of 1772mA/m² at 82Ω. With 180-Ω external resistance, one set of the electrodes on the same side could generate more power density of 832±4mW/m² with current generation of 1923±4mA/m². The anode, inclusive a biofilm behaved ohmic, whereas a Tafel type behavior was observed for the oxygen reduction. The various impedance contributions from electrodes, electrolyte and membrane were analyzed and identified by electrochemical impedance spectroscopy. Air flow rate to the cathode chamber affected microbial voltage generation, and higher power generation was obtained at relatively low air flow less than 2mL/min.

General information
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Organisations: Department of Environmental Engineering, Department of Energy Conversion and Storage, Imaging and Structural Analysis, Department of Chemical and Biochemical Engineering, Center for BioProcess Engineering, Residual Resource Engineering
Contributors: Min, B., Poulsen, F. W., Thygesen, A., Angelidaki, I.
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Peer-reviewed: Yes

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Web of Science (2012): Impact factor 4.75
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Research output: Contribution to journal > Journal article – Annual report year: 2012 > Research > peer-review

Studies of rubidium selenate with secondary phase of RbOH under humidified reducing atmosphere

The high temperature properties of Rb₂SeO₄ have been studied by calorimetry, impedance spectroscopy and X-ray powder diffraction. As synthesized, Rb₂SeO₄ includes a second phase of Rb₂SeO₃, which can be eliminated upon heating the compound. As expected, no conductivity is observed in dry (pH₂O < 0.001 bar) air. By changing to humidified (pH₂O = 0.1 bar) air at 176 deg. C, the conductivity increases sharply from 8.6·10⁻⁸ to 1.7·10⁻⁶ S cm⁻¹. Under humidified (pH₂O = 0.1 bar) reducing atmosphere (9%H₂ in N₂), the conductivity increases to 2.0·10⁻⁴ S cm⁻¹ at 317 C. Degradation of Rb₂SeO₃ and Rb₂SeO₄ to form RbOH, which is known as a proton conductor, are thought to be responsible for the observed conductivity in humidified atmospheres. Our observations may explain the conductivity rise in other solid acid electrolytes, including sulfate and selenate groups, around their decomposition temperatures, in humidified atmospheres.

Studies of rubidium selenate with secondary phase of RbOH under humidified reducing atmosphere
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Electricity generation by microbial fuel cells fuelled with wheat straw hydrolysate

Electricity production from microbial fuel cells fueled with hydrolysate produced by hydrothermal treatment of wheat straw can achieve both energy production and domestic wastewater purification. The hydrolysate contained mainly xylan, carboxylic acids, and phenolic compounds. Power generation and substrate utilization from the hydrolysate was compared with the ones obtained by defined synthetic substrates. The power density increased from 47 mW m−2 to 148 mW m−2 with the hydrolysate:wastewater ratio (RHW in m3 m−3) increasing from 0 to 0.06 (corresponding to 0–0.7 g dm−3 of carbohydrates). The power density with the hydrolysate was higher than the one with only xylan (120 mW m−2) and carboxylic acids as fuel. The higher power density can be caused by the presence of phenolic compounds in the hydrolysates, which could mediate electron transport. Electricity generation with the hydrolysate resulted in 95% degradation of the xylan and glucan. The study demonstrates that lignocellulosic hydrolysate can be used for co-treatment with domestic wastewater for power generation in microbial fuel cells.

General information
Publication status: Published
Organisations: Bioenergy and Biomass, Biosystems Division, Rise National Laboratory for Sustainable Energy, Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Residual Resource Engineering, Department of Environmental Engineering, Kyung Hee University
Contributors: Thygesen, A., Poulsen, F. W., Angelidaki, I., Min, B., Thomsen, A. B.
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Peer-reviewed: Yes

Publication information
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Web of Science (2011): Impact factor 3.646
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Original language: English
NdHO, a novel oxyhydride
A new metal oxyhydride; neodymium oxyhydride, NdHO, has been synthesized from a reactant mixture of metal hydride (CaH2 or NdH3) and neodymium oxide(Nd2O3). The unit cell dimensions decrease smoothly in the series from LaHO, CeHO, PrHO to NdHO, in line with the lanthanide contraction. The crystal structure of NdHO is described on the basis of Rietveld refinement on neutron powder diffraction data: Space group: P4/nmm (no. 129,D4h 7 ). Axis lengths: a=%7.8480(5) Å, c=%5.5601(8) Å. Volume: V=%342.46(6) Å³. The tetragonal structure is derived from the fluorite structure, showing complete ordering of hydride and oxide ions over the anion sublattice. The formation of NdHO was further substantiated by Raman spectroscopy.

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Energy and Materials, Department of Chemistry, University of Oslo
Contributors: Widerøe, M., Fjellvåg, H., Norby, T., Poulsen, F. W., Berg, R. W.
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Web of Science (2011): Impact factor 2.159
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Web of Science (2011): Indexed yes
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Source: orbit
Source-ID: 278104
Research output: Contribution to journal › Journal article – Annual report year: 2011 › Research › peer-review

Structural, magnetic and magnetocaloric properties of Heusler alloys Ni50Mn38Sb12 with boron addition
We report on the structural, magnetic and magnetocaloric properties of the Ni50Mn38Sb12Bx alloys in term of boron addition with x=1, 3 and 5. We have found that both the paramagnetic–ferromagnetic austenitic transition (TC) and the ferromagnetic–antiferromagnetic martensitic transition (TM) are sensitively influenced by the boron addition: TC tends to increase, while TM decreases with increasing boron concentration. Temperature dependent X-ray diffraction in the range of 200–500K clearly shows an evolution of the structural transformation from orthorhombic to cubic structure phase transition on heating for the x=1 and 3 samples. Strikingly, the addition of boron atoms into the lattice favours the ferromagnetic ordering relatively to the antiferromagnetic arrangement below TM. This consequently affects on the magneto-structural transition as well as on the size of magnetocaloric effect.

General information
Publication status: Published
Organisations: Thermo Ceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Microstructures and Interfaces, Hanoi University of Science and Technology, PetroVietNam University, Delft University of Technology
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Publication date: 2011
Peer-reviewed: Yes
Conductivity and Defect Chemistry Modeling of Oxygen Nonstoichiometry in Cr1+B;Mn2-#B;O4 Spinels

General information
Publication status: Published
Organisations: Electroceramics, Fuel Cells and Solid State Chemistry Division, Rise National Laboratory for Sustainable Energy, Physical Chemistry, Department of Chemistry
Contributors: Østby, J. A., Poulsen, F. W., Jacobsen, T.
Pages: Abstract 731
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Source: orbit
Source-ID: 264325
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2010 › Research › peer-review

A novel oxyhydride, NdHO
Poster on structure and Raman spectrum of the unusual Neodymium(III) oxy hydride presented at the conference

General information
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Contributors: Widerøe, M., Fjellvåg, H., Poulsen, F. W., Berg, R. W.
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Source-ID: 257557
Research output: Contribution to conference › Poster – Annual report year: 2009 › Research › peer-review

LSM-YSZ Reactions in Different Atmospheres
The influences of the oxygen partial pressure and the LSM/YSZ ratio on the LSM-YSZ interface reactions at 1,000 °C were investigated. Both pellets and diffusion couples were employed in the study. The equilibrium thermodynamics of the LSM-YSZ reactions was clarified based on the pellet study-powder reaction. LSM reacts differently with YSZ in different atmospheres. In air, m-ZrO2 (monoclinic) is formed; while in N2, SrZrO3 and/or La2Zr2O7 are formed depending on the
initial LSM/YSZ ratio. The reactions are reversible with varying P(O2) i.e. treating the sample in air after the heat treatment in N2 results in a decomposition of the formed La- and Sr-zirconates. The de-stabilisation of the LSM-YSZ interface under long-term annealing at 1,000 °C originates mainly from the inter-diffusion across the interface. Under reduced P(O2), the Mn diffusion from LSM into YSZ is enhanced. High P(O2) (0.21 atm) promotes the m-ZrO2 formation.

**General information**
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Organisations: Electroceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Microstructures and Interfaces, Electrochemical Evaluation
Contributors: Chen, M., Liu, Y., Hagen, A., Hendriksen, P. V., Poulsen, F. W.
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Publication date: 2009
Peer-reviewed: Yes

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Web of Science (2009): Indexed yes
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Source: orbit
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Research output: Contribution to journal › Journal article – Annual report year: 2009 › Research › peer-review

**Microstructural studies on degradation of interface between LSM–YSZ cathode and YSZ electrolyte in SOFCs**
The changes in the cathode/electrolyte interface microstructure have been studied on anode-supported technological solid oxide fuel cells (SOFCs) that were subjected to long-term (1500 h) testing at 750 °C under high electrical loading (a current density of 0.75 A/cm2). These cells exhibit different cathode degradation rates depending on, among others, the composition of the cathode gas, being significantly smaller in oxygen than in air. FE-SEM and high resolution analytical TEM were applied for characterization of the interface on a submicron- and nano-scale. The interface degradation has been identified as the loss of LSM coverage and the loss of three-phase-boundary (TPB) length. Firstly, the degradation is caused by the size reduction of the individual LSM/YSZ electrolyte contact points (areas) that are initially of 100–200 nm in diameter. Quantitative microstructure evaluation shows that in the cell tested in air this mechanism contributes to an estimated overall reduction in the LSM coverage and the TPB length by 50 and 30%, respectively. For the cell tested in oxygen the corresponding values are 10 and 4%. Secondly, in the cell tested in air the LSM coverage and the TPB length appear to decrease further due to the more pronounced formation of insulating zirconate phases that are present locally and preferably in LSM/YSZ electrolyte contact areas. The effects of the cathode gas on the interface degradation are discussed considering the change of oxygen activity at the interface, possible changes in the Mn diffusion pattern as well as the LSM/YSZ reactivity. Finally, based on thermodynamic calculations a T–p(O2) diagram predicting the safe and risky operation conditions in terms of the zirconate formation is presented and compared with the experimental observations.

**General information**
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Electrochemical Evaluation, Electroceramics
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NdHO, a novel oxy hydride

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Organisations: Electroceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Publication date: 2009
Peer-reviewed: No
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Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2009 › Research

The effect of different substrates and humic acid on power generation in microbial fuel cell operation

General information
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Organisations: Bioenergy and Biomass, Biosystems Division, Risø National Laboratory for Sustainable Energy, Electroceramics, Fuel Cells and Solid State Chemistry Division, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Thygesen, A., Poulsen, F. W., Min, B., Angelidaki, I., Thomsen, A. B.
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ISSN (Print): 0960-8524
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Scopus rating (2009): SJR 1.915 SNIP 2.236
Web of Science (2009): Indexed yes
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Research output: Contribution to journal › Journal article – Annual report year: 2009 › Research › peer-review

Degradation mechanisms on LSM/YSZ electrodes

General information
Publication status: Published
Organisations: Electroceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Microstructures and Interfaces, Electrochemistry
Contributors: Hendriksen, P. V., Liu, Y., Chen, M., Barfod, R., Poulsen, F. W., Hagen, A.
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Event: Paper presented at 32nd International Conference and Expo on Advanced Ceramics and Composites, Daytona Beach, FL, United States.
Microbial fuel cells with acetate, glucose and xylose - an electrochemical study

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Publication status: Published
Organisations: Bioenergy and Biomass, Biosystems Division, Rise National Laboratory for Sustainable Energy, Electroceramics, Fuel Cells and Solid State Chemistry Division
Contributors: Thygesen, A., Poulsen, F. W., Thomsen, A. B.
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Event: Poster session presented at Conference on Electrochemical Science and Technology, Odense, Denmark.
Keywords: Bio energy, Microbial energy technology
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Research output: Contribution to conference › Poster – Annual report year: 2008 › Research

Microbial fuel cells with acetate, glucose and xylose using humic acid as mediator

General information
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Organisations: Bioenergy and Biomass, Biosystems Division, Rise National Laboratory for Sustainable Energy, Electroceramics, Fuel Cells and Solid State Chemistry Division, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Thygesen, A., Poulsen, F. W., Min, B., Angelidaki, I., Thomsen, A. B.
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Peer-reviewed: No
Event: Poster session presented at 1. International symposium on microbial fuel cells, State College, USA.
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Modelling of oxides for use in high temperature fuel cells

General information
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Organisations: Electroceramics, Fuel Cells and Solid State Chemistry Division, Rise National Laboratory for Sustainable Energy
Contributors: Bork, N. C., Chen, M., Poulsen, F. W.
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Source-ID: 222833
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2008 › Research › peer-review

Conductivity and electrochemical characterization of PrFe_{1-x}Ni_{x}O_{3-delta} at high temperature
PrFe_{1-x}Ni_{x}O_{3-delta} (x=0.4-0.6) compounds were synthesized and characterized by powder XRD, electrical conductivity and electrochemical impedance spectroscopy on point electrodes on a Ce0.9Gd0.1O2-delta (CGO10) electrolyte. As a reference, the electrochemical performance of LaFe(0.4)AM(0.6)O(3-delta) was also measured. The main phase in the PrFe_{1-x}Ni_{x}O_{3-delta} series was perovskite-type structure and belonged to the orthorhombic crystal system. The conductivities are fairly high, e.g. around 220 S cm(-1) at 873 K for the x = 0.4 compound. The electrochemical
performance of the PrFe(1-x)NiO(3-delta) series is similar to that of La0.6Sr0.4Fe0.8Co0.2O3-delta, which is a good candidate as a cathode material for SOFCs operating at intermediate temperature. The electrochemical performance of LaFe0.4Ni0.6O3-delta was even higher than that of the PrFe1-xNiO3-delta, series and the polarization resistance was 0.14 Omega cm(2) at 1073 K measured on a point electrode. (c) 2006 Elsevier B.V. All rights reserved.

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Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy, Electrochemistry, Fuel Cells and Solid State Chemistry Division, Electroceramics
Contributors: Hashimoto, S., Kammer Hansen, K., Poulsen, F. W., Mogensen, M. B.
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Publication date: 2007
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Journal: Journal of Alloys and Compounds
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Web of Science (2007): Indexed yes
Original language: English
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Source: orbit
Source-ID: 216614
Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review

Conductivity of SrTiO3 based oxides in the reducing atmosphere at high temperature
The conductivities of several donor-doped SrTiO3 based oxides, which were prepared in air, were studied in a reducing atmosphere at high temperature. The conductivities of all specimens increased slowly with time at 1000 degrees C in 9% H-2/N-2, even after 100 h. Nb-doped SrTiO3 showed relatively fast reduction and high conductivity compared with the other SrTiO3 based oxides. The conductivity of Nb-doped SrTiO3 was ca. 50 S cm(-1) at 500 degrees C after reduction at 1200 degrees C. After strong reduction, the conductivity of Nb-doped SrTiO3 was almost independent of the oxygen partial pressure at 500-800 degrees C, while that of La-doped SrTiO3 dropped immediately on exposure to air. The conduction behavior of Nb-doped SrTiO3 was explained by reduction of Ti4+ and/or Nb5+ and the relatively slow oxygen diffusibility. (c) 2006 Elsevier B.V. All rights reserved.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy, Electroceramics, Fuel Cells and Solid State Chemistry Division, Electrochemistry
Contributors: Hashimoto, S., Poulsen, F. W., Mogensen, M. B.
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Publication date: 2007
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Journal: Journal of Alloys and Compounds
Volume: 439
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Web of Science (2007): Indexed yes
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Source: orbit
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Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review
Oxygen nonstoichiometry and transport properties of strontium substituted lanthanum cobaltite

Oxygen nonstoichiometry, structure and transport properties of the two compositions (La-0.6 Sr-0.4)(0.99)CoO3-delta (LSC40) and La0.85Sr0.15CoO3-delta (LSC15) were measured. It was found that the oxygen nonstoichiometry as a function of the temperature and oxygen partial pressure could be described using the itinerant electron model. The electrical conductivity, sigma, of the materials is high (sigma > 500 S cm(-1)) in the measured temperature range (650 - 1000 degrees C) and oxygen partial pressure range (0.209-10(-4) atm). At 900 degrees C the electrical conductivity is 1365 and 1491 S cm(-1) in air for LSC40 and LSC15, respectively. A linear correlation between the electrical conductivity and the oxygen vacancy concentration was found for both samples. The mobility of the electron-holes was inversely proportional with the absolute temperature indicating a metallic type conductivity for LSC40. Using electrical conductivity relaxation the chemical diffusion coefficient of oxygen was determined. It was found that accurate values of the chemical diffusion coefficient could only be obtained using a sample with a porous surface coating. The porous surface coating increased the surface exchange reaction thereby unmasking the chemical diffusion coefficient. The ionic conductivity deduced from electrical conductivity relaxation was determined to be 0.45 S cm(-1) and 0.01 S cm(-1) at 1000 and 650 degrees C, respectively. The activation energy for the ionic conductivity at a constant vacancy concentration (delta = 0.125) was found to be 0.90 eV. (c) 2006 Elsevier B.V. All rights reserved.

Testing of Ni-plated ferritic steel interconnect in SOFC stacks

Stack tests were run at 850°C for periods from 80 hours to 1,150 hours to develop contacting procedures and at the same time evaluate the performance of a 5 μm electroplated nickel coating on a ferritic Fe22Cr interconnect. The metallic nickel coating reacted relatively quickly during the initial heating to 1,030°C. During this time, 20–70 μm thick surface layers of austenitic steel were formed, which were covered by a 1–4 μm chromia layer on the anode side and by a layer of mixed Cr-Fe-Ni-spinels over a 1–4 μm chromia layer on the cathode side. The microstructure and composition of the protective scale on the cathode side was susceptible to pitting-type corrosion patterns, which may limit the life expectancy to less than 2,000 hours for the 200 μm thick interconnect tested. The initial area-specific resistances (ASR) at the
interconnect/cathode current collector interface and the interconnect/anode current collector interface were very low (2 and 10 mΩ cm², respectively). The cathode side interface resistance increased over the 1,150 hours by ~7 mΩ cm²/10³ h, but the anode side interface resistance decreased during the first 600 hours of the experiment before it started to show a slight increase, < 1 mΩ cm²/10³ h, maintaining values below 1 mΩ cm².

A study of Pr₀.7Sr₀.3Fe₁₋ₓNixo₃₋δ as a cathode material for SOFCs with intermediate operating temperature

Pr₀.7Sr₀.3Fe₁₋ₓNixo₃₋δ (PSFN; x=0.2-0.5) compounds were synthesized and characterized by powder X-ray diffraction (XRD), thermal expansion coefficient (TEC) measurements, electrical conductivity and electrochemical impedance spectroscopy on cone-shaped electrodes on a Ce₀.9Gd₀.1O₁.₉₅ (CGO₁₀) electrolyte. The main phase of the powders belongs to the orthorhombic crystal system. The conductivities are fairly high, e.g., around 450 Scm⁻¹ at 600 °C for the x=0.3 compound. The TEC of the compounds is close to the values of ceria-based electrolytes. PSEN showed hysteresis in the temperature dependence of the conductivity, TEC and area-specific polarization resistance Rpol. It is considered that the hysteresis was caused by relatively slow adjustment of the oxygen stoichiometry. The electrochemical La₀.₆Sr₀.₄Fe₀.₈Co₀.₂O₃₋δ showed hysteresis in the temperature dependence of the conductivity, TEC and area-specific polarization resistance Rpol. © 2004 Elsevier B.V. All rights reserved.
A study on the structural and electrical properties of lanthanum-doped strontium titanate prepared in air

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Contributors: Hashimoto, S., Kindermann, L., Poulsen, F., Mogensen, M. B.
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Defect modeling

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Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
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Determination of transport and catalytic properties of mixed ionic and electronic conductors using transient responses

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Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Søgaard, M., Hendriksen, P., Poulsen, F.
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Development of a defect code for proton containing K2NiF4 type of oxides

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Organisations: Risø National Laboratory for Sustainable Energy
Electrical conductivity and dimensional stability of co-doped lanthanum chromites

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Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hendriksen, P., Høgh, J., Hansen, J., Larsen, P., Mogensen, M., Poulsen, F.
Publication date: 2005
Peer-reviewed: No
Source: orbit
Source-ID: 308057
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2005 › Research

High temperature structural phase transitions in SrSnO₃ perovskite

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Glerup, M., Knight, K., Poulsen, F.
Pages: 507-520
Publication date: 2005
Peer-reviewed: Yes
Publication information
Journal: Materials Research Bulletin
Volume: 40
ISSN (Print): 0025-5408
Ratings:
Scopus rating (2005): SJR 0.613 SNIP 1.191
Web of Science (2005): Indexed yes
Original language: English
DOIs:
10.1016/j.materresbull.2004.11.004
Source: orbit
Source-ID: 307896
Research output: Contribution to journal › Journal article – Annual report year: 2005 › Research › peer-review

Investigations of the influence of glass phase to the lanthanum rich mischmetal

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Grinberga, L., Kleperis, J., Pedersen, A., Poulsen, F.
Publication date: 2005
Peer-reviewed: No
Event: Abstract from 3rd Annual Meeting in the Copenhagen Graduate School for Nanoscience and Nanotechnology, Copenhagen, Denmark.
URLs:
Source: orbit
Source-ID: 308800
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2005 › Research
Solid state electrochemistry. Proceedings

General information
Publication status: Published
Organisations: Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Number of pages: 388
Publication date: 2005

Publication information
Place of publication: Roskilde
Publisher: Risø National Laboratory
ISBN (Print): 87-550-3455-1
Original language: English
Source: orbit
Source-ID: 308373
Research output: Book/Report › Book – Annual report year: 2005 › Research › peer-review

Why are we waiting for the Solid Oxide Fuel Cell technology? - A glimpse into the Danish SOFC program

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 2005
Peer-reviewed: No
Event: Abstract from FUNMAT seminar, Oslo, Norway.
Source: orbit
Source-ID: 308616
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2005 › Research

A study of Pr$_{0.7}$Sr$_{0.3}$Fe$_{1-x}$Ni$_x$O$_{3-δ}$ as a cathode material for intermediate temperature operating SOFCs

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hashimoto, S., Kammer Hansen, K., Larsen, P., Poulsen, F., Mogensen, M. B.
Pages: 118-121
Publication date: 2004

Host publication information
Title of host publication: Extended abstracts
Place of publication: Tokyo
Publisher: Solid Oxide Fuel Cell Society of Japan
Source: orbit
Source-ID: 307046
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2004 › Research

A study of Pr$_{0.7}$Sr$_{0.3}$Fe$_{1-x}$Ni$_x$O$_{3-δ}$ as an SOFC cathode material

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hashimoto, S., Kammer Hansen, K., Larsen, P., Poulsen, F., Mogensen, M. B.
Pages: 42-43
Publication date: 2004

Host publication information
Title of host publication: Extended abstracts
Place of publication: Tokyo
Publisher: Solid State Ionics Society of Japan
Source: orbit
A study on the properties of SrTiO$_3$ based oxides at high temperature

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hashimoto, S., Kindermann, L., Larsen, P., Poulsen, F., Mogensen, M. B.
Pages: 146-147
Publication date: 2004

Determination of the structure of cubic stabilised zirconia using Raman spectroscopy

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Glerup, M., Nielsen, O., Poulsen, F.
Pages: 25-31
Publication date: 2004
Peer-reviewed: Yes

Electrical conductivity and dimensional stability of co-doped lanthanum chromites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hendriksen, P., Høgh, J., Hansen, J., Larsen, P., Mogensen, M., Poulsen, F.
Publication date: 2004
Peer-reviewed: No
Event: Abstract from Joint International Meeting: Meeting of the Electrochemical Society, Fall meeting of the Electrochemical Society of Japan, Honolulu, HI, United States.
Source: orbit
Source-ID: 307615
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2004 › Research

Evaluation of sodium aluminosilicate glass composite seal with magnesia filler

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Nielsen, K., Solvang, M., Poulsen, F., Larsen, P.
Pages: 309-314
Publication date: 2004
Factors controlling the oxide ion conductivity of fluorite and perovskite structured oxides

Many metal oxides of fluorite and perovskite related structures are oxide ion conductors, which have practical applications in devices such as oxygen sensors, solid oxide fuel cells (SOFC) and electrolyzers. Several structural and thermodynamic parameters such as (1) critical radius of the pathway for the oxide ion movement, (2) free lattice volume, and (3) average metal-oxide bond energy have been proposed as predictors of high oxide ion conductivity. We discuss how these parameters all depend on ionic radii, and therefore, some of these may be redundant. Furthermore, we explore the interrelations among such parameters for fluorite and perovskite oxides by considering their sensitivities to the individual ionic radii. Based on experimental data available in the literature, it is argued that lattice distortion (lattice stress and deviation from cubic symmetry) due to ion radii mismatch determines the ionic conductivity to a very large extent, and that lattice distortion is of much greater importance than many other proposed parameters. In case of the perovskites, the charge of the B-site ion is also of major importance. (C) 2004 Published by Elsevier B.V.
Cellulose as a binding material in graphitic anodes for Li ion batteries: A performance and degradation study

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Drofenik, J., Gaberscek, M., Dominko, R., Poulsen, F., Mogensen, M. B., Pejovnik, S., Jamnik, J.
Pages: 883-889
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Electrochimica Acta
Volume: 48
ISSN (Print): 0013-4686
Web of Science (2003): Indexed yes
Original language: English
DOI: 10.1016/S0013-4686(02)00784-3
Source-ID: 305384
Research output: Contribution to journal › Journal article – Annual report year: 2003 › Research › peer-review


General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Number of pages: 32
Publication date: 2003

Publication information
Place of publication: Roskilde
Publisher: Risø National Laboratory, Materials Research Department
Original language: English
Source-ID: 305733
Research output: Book/Report › Report – Annual report year: 2003 › Research › peer-review

Investigations of defect chemistry models - pitfalls and progress

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Peer-reviewed: No
Event: Abstract from Defect Chemistry Workshop, Karlsruhe, Germany.
Source-ID: 306244
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2003 › Research

Numerical codes for acceptor doped SrTiO3 - a black board demonstration

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 2003
Phase transitions in undoped BaCeO₃

The linear thermal expansion (370-1500 K) and electrical conductivity (950-1220 K) have been measured for undoped BaCeO₃ in dry air, pH₂O = 40 Pa. Samples were made both by conventional sintering and by solidification from inductive melting. Raman spectra were measured from 298 to 773 K. The obtained temperature dependencies, ΔL(T) and σ(T) upon heating and cooling, were treated mathematically by the method of differences (difference between experimental points and approximating the dependence by a first degree polynomial). This permitted to determine the position and the order of the structural phase transitions in BaCeO₃. Five second-order transitions at 480 +/- 10, 530 +/- 10, 900 +/- 10, 1030 +/- 20 and 1170 +/- 20 K, and also one first-order transition at 665 +/- 10 K, were found. The transitions at 900 and 1030 K have not been reported before. (C) 2003 Elsevier B.V. All rights reserved.

Universal defect codes for acceptor- and donor doped SrTiO₃

Crystallographical aspects of high temperature fuel cell materials
Defect chemistry modelling of complex SOFC materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Søgård, M.
Pages: 687-694
Publication date: 2002

Host publication information
Title of host publication: Proceedings. Vol. 2
Place of publication: Oberrohrdorf (CH)
Publisher: European Fuel Cell Forum
Editor: Huijsmans, J.
ISBN (Print): 3-905592-10-X
Source: orbit
Source-ID: 304286
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2002 › Research

Defektkemi: teori og eksperimenter

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 2002
Peer-reviewed: No
Event: Abstract from Seminar om SOFC-forskning på Risø, Risø, Denmark.
Source: orbit
Source-ID: 303883
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2002 › Research

Fuel cells

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 29-31
Publication date: 2002

Host publication information
Title of host publication: Risø energy report 1. New and emerging technologies - options for the future
Editors: Larsen, H., Sønderberg Petersen, L.
ISBN (Print): 87-550-3081-5
(Denmark. Forskningscenter Risoe. Risoe-R; No. 1351(EN)).
Keywords: Risø-R-1351(EN), Risø-R-1351
Electronic versions: ris_r_1351.pdf
Source: orbit
Source-ID: 305004
Research output: Chapter in Book/Report/Conference proceeding › Book chapter – Annual report year: 2002 › Research › peer-review

Fuel cells
Tautology of defect chemistry models?

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 2002
Peer-reviewed: No
Source: orbit
Source-ID: 304141
Research output: Contribution to conference > Conference abstract for conference – Annual report year: 2002 > Research

The effect of lattice stress in ion conducting fluorites and perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Mogensen, M. B., Lybye, D., Bonanos, N., Hendriksen, P., Poulsen, F.
Pages: 15-26
Publication date: 2002

Host publication information
Title of host publication: Proceedings
Place of publication: Pennington, NJ
Publisher: The Electrochemical Society
Editors: Ramanarayanan, T., Worrell, W., Mogensen, M.
Source: orbit
Source-ID: 303948
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 2002 > Research > peer-review

The ferroelectric to paraelectric phase transition in Pb(Zr,Ti)O₃ (PZT)

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ståhl, K., Nielsen, E., Ringgaard, E., Poulsen, F.
Publication date: 2002

Host publication information
Title of host publication: Abstracts
Place of publication: Lyngby
Publisher: Technical University of Denmark (DTU)
Editor: Ståhl, K.
Source: orbit
Source-ID: 304135
Research output: Chapter in Book/Report/Conference proceeding > Conference abstract in proceedings – Annual report year: 2002 > Research

Vibrational spectroscopy on protons and deuterons in proton conducting perovskites

A short review of IR-spectroscopy on protons in perovskite structure oxides is given. The nature of possible proton sites, libration and combination tones and degree of hydrogen bonding is emphasised. Three new spectroscopic experiments and/or interpretations are presented. An IR-microscopy experiment was performed on the protonic conductor Ba-3(Ca1-chiNb2-chi)O9-delta, x = 0.18. The H/D concentration profile of a cross-section of the sample after partial isotopic exchange can be visualised; proton containing La0.9Ca0.1ErO3 was studied up to 200degreesC by Raman spectroscopy.
At 200 degrees C, the OH-stretch cannot be observed due to thermal broadening, but the peak reappears upon cooling; the OH and OD absorption bands in BaCe1-chiNdchiO3 are very broad and, in addition, an electronic transition of Nd-3 is observed at 1900-1930 cm(-1); finally, IR reflectance spectroscopy on BaZr0.9Y0.1O3, La0.8Sr0.2ScO3, La0.9Sr0.1Sc0.9Mg0.1O3 and SrCe0.95Y0.05O3 shows at least three types of proton positions. (C) 2002 Published by Elsevier Science B.V.
Development and scale-up of anode-supported SOFC

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Publication date: 2001

Host publication information
Title of host publication: Proceedings
Publisher: Werkstoffwoche-Partnerschaft
URLs:
http://www.materialswweek.org/proceedings/index.htm

Nucleation of iron nitrides during gaseous nitriding of iron; Effect of a preoxidation treatment

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Friehling, P., Poulsen, F., Somers, M.
Pages: 589-595
Publication date: 2001
Peer-reviewed: Yes

Publication information
Journal: Zeitschrift für Metallkunde
Volume: 92
ISSN (Print): 0044-3093
Ratings:
Web of Science (2001): Indexed yes
Original language: English
Source: orbit
Source-ID: 302773
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Research › peer-review

Nucleation of iron nitrides during gaseous nitriding of iron; the effect of a preoxidation treatment

The nucleation of iron nitrides during gaseous nitriding has been investigated using light microscopy and X-ray diffraction. Initially, the nucleation of gamma'-Fe4N1-x on a pure iron surface starts at grain boundaries meeting the surface, from where the nitride grains grow laterally into the iron grains. On prolonged nitriding, immediate nucleation at the surface of iron grains becomes possible. Calculated incubation times for the nucleation of gamma'-Fe4N1-x during nitriding are generally longer than those observed experimentally in the present work. The incubation time is reduced dramatically after oxidation of the iron surface prior to nitriding. Furthermore, a more uniform distribution of iron-nitride nuclei over the surface is obtained after preoxidation. The enhanced nucleation of iron nitrides on oxidised iron is discussed in terms of the kinetics of the surface reactions, and the development of a metastable precursor for nitride formation.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy, Department of Management Engineering
Contributors: Friehling, P. B., Poulsen, F. W., Somers, M. A.
Pages: 589-595
Publication date: 2001
Peer-reviewed: Yes

Publication information
Journal: Zeitschrift für Metallkunde
Phase equilibria and microstructure in $\text{Sr}_4\text{Fe}_{6-x}\text{Co}_x\text{O}_{13}$ $0 \leq x \leq 4$ mixed conductors

The densification, microstructure and phase evolution of $\text{Sr}_4\text{Fe}_{6-x}\text{Co}_x\text{O}_{13}$ ($0 \leq x \leq 4$) materials have been investigated by powder X-ray diffraction, electron microscopy and thermal analysis. Powders were prepared by the solid state reaction method or by the EDTA precursor method. Pure $\text{Sr}_4\text{Fe}_6\text{O}_{13}$ is stable above 775 +/- 25 degreesC in air until it melts peritectically at 1220 +/- 5 degreesC. Below 775 degreesC, $\text{Sr}_4\text{Fe}_6\text{O}_{13}$ is unstable with respect to the formation of $\text{Sr}_1-x\text{FeO}_{3-delta}$ and $\text{SrFe}_{12}\text{O}_{19}$. Co substituted $\text{Sr}_4\text{Fe}_6\text{O}_{13}$ is only stable in a narrow temperature region near 900 degreesC. At higher or lower temperature, the Co-content is reduced due to formation of the perovskite $\text{SrFe}_1-z\text{Co}_z\text{O}_{3-delta}$ and the solid solutions $\text{CO}_3-y\text{Fe}_y\text{O}_4$ (below 900 degreesC) or $\text{Co}_1-y\text{Fe}_y\text{O}$ (above 900 degreesC). A plate-like morphology of $\text{Sr}_4\text{Fe}_6-x\text{Co}_x\text{O}_{13}$ grains was observed both in calcined powders and in sintered ceramics. Ball milling of the calcined powders was necessary prior to the sintering in order to achieve dense materials in the temperature region 1120-1170 degreesC. Only pure $\text{Sr}_4\text{Fe}_6\text{O}_{13}$ appeared as a single-phase material after sintering. Increasing amounts of the phases $\text{SrFe}_1-z\text{Co}_z\text{O}_{3-delta}$ and $\text{Co}_1-y\text{Fe}_y\text{O}$ were observed with increasing sintering temperature and increasing Co-content due to the limited solubility of Co in $\text{Sr}_4\text{Fe}_6-x\text{Co}_x\text{O}_{13}$. The thermal expansion coefficient of the materials deviates from linear behavior due to the decreasing oxidation state of iron with increasing temperature. The present investigation demonstrates that $\text{Sr}_4\text{Fe}_4\text{Co}_2\text{O}_{13}$ materials with high oxygen permeability are not single-phase materials when sintered at high temperature. (C) 2001 Elsevier Science B.V. All rights reserved.

Speculations on the existence of hydride ions in proton conducting oxides

The chemical and physical nature of the hydride ion is briefly treated. Several reactions of the hydride ion in oxides or oxygen atmosphere are given, A number of perovskites and inverse perovskites are listed. which contain the H- ion on the oxygen or B-anion sites in the archetype $\text{ABO}_3$ System. H- is stable with respect to oxide and halide anions but, among cations only with respect to oxides and halides of strongly electronegative metals such as alkaline, alkaline-earth and main group III metals. H- is only stable in combination with transition metal ions of certain elements in their lowest positive oxidation state. Mixed oxide/hydride containing perovskites may thus exist. Steinsvik et al. have recently suggested a defect model for a perovskite including substitutional hydride ions on the oxygen site, $\text{H-O}(.)$, and protons associated with a lattice oxygen, $\text{OH}$. The defect equations for this acceptor doped $\text{A(II)}\text{B(IV)}\text{O}_3$ model compound are solved without using the conventional Brouwer approximations, One case is presented where hydride formation is suppressed, and another case where it is promoted. Plots of concentration versus water and oxygen partial pressures show new interesting features these are discussed. (C) 2001 Elsevier Science B.V. All rights reserved.
Conductivity of A- and B-site doped LaAlO₃, LaGaO₃, LaScO₃ and LaInO₃ perovskites

The conductivity of the materials LaAlO₃, LaGaO₃, LaScO₃ and LaInO₃ all doped with 10% strontium on the A-site and 10% magnesium at the B-site has been measured at different temperatures and oxygen partial pressures. The doped LaGaO₃ is found to be an almost pure ionic conductor with a conductivity of 95 mS/cm at 800 degrees C. The conductivity of doped LaGaO₃ decreases with time due to precipitation of a secondary phase. The doped LaAlO₃ and LaScO₃ are mixed conductors in oxidising atmosphere. Their ionic conductivities at 800 degrees C are 1.3 and 0.5 mS/cm, respectively. The conductivities given are total conductivities. The large difference in the conductivities of the investigated materials seems to be caused partly by grain boundary resistance. (C) 2000 Elsevier Science B.V. All rights reserved.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Lybye, D., Poulsen, F., Mogensen, M. B.
Pages: 91-103
Publication date: 2000
Peer-reviewed: Yes

Publication information
Journal: Solid State Ionics
Volume: 128
Issue number: 1-4
ISSN (Print): 0167-2738
Ratings:
Scopus rating (2000): SJR 1.161 SNIP 1.312
Web of Science (2000): Indexed yes
Original language: English
DOIs: 10.1016/S0167-2738(99)00337-9
Source: orbit
Source-ID: 302775
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Research › peer-review

Defect chemistry modelling of oxygen-stoichiometry, vacancy concentrations, and conductivity of (La₁₋ₓSrₓ)(₃−₄₋ₓ)MnO₃ +/−δ

Two precise algorithms are devised for the calculation of defect concentrations in A-site acceptor doped ABO₃ perovskites. The two models contain nine species including cation vacancies on the A- and B-site. The small polaron model is based on three redox levels of the B-ion. A large polaron model, based on delocalised electrons, electron holes and all B-ions being trivalent is given in Appendix A. The sequential mathematical method allows us to calculate the high temperature oxygen partial pressure dependent properties of (La₁₋ₓSrₓ)(₃−₄₋ₓ)MnO₃+/−δ in a unified manner irrespective of the type of defect regime. Simulations are shown for a pO₂ span from 10⁻³⁰ to 10⁻¹⁰ atm. The three required equilibrium constants for (La₁₋ₓSrₓ)(₃−₄₋ₓ)MnO₃+/−δ had to be changed significantly from values given in literature in order to match the observed stoichiometry span. The main results shown are calculated by the small polaron model containing only ionic species - the B-ion may be Mn-B’ (Mn²⁺), Mn-B(x) (Mn³⁺), and Mn-B(Mn⁴⁺). The A/B-ratio = y greatly influences the oxygen stoichiometry, oxygen ion vacancy- and cation vacancy concentrations and the total conductivity. Calculations are given for the range 0.87 ≤ y ≤ 1.13 for a Sr doping of 10% at 1000 degrees C. The defect model can simultaneously describe the observed stoichiometry and conductivity dependence on pO₂, if the electronic mobility is decreased by up to 50% at pO₂ < 10⁻¹⁰ and pO₂ > 10⁻² atm. (C) 2000 Elsevier Science B.V. All rights reserved.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 145-162
Publication date: 2000
Peer-reviewed: Yes

Publication information
Journal: Solid State Ionics
Development and scale-up of anode-supported SOFC

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Publication date: 2000
Peer-reviewed: No
Source: orbit
Source-ID: 300921
Research output: Contribution to journal › Journal article – Annual report year: 2000 › Research › peer-review

Electrical conductivities and chemical stabilities of mixed conducting pyrochlores for SOFC applications

Pyrochlores with praseodymium as the A-site cation and zirconium, tin, cerium and manganese cations on the B-site were prepared in air and their electrical conductivities were investigated as a function of oxygen partial pressure and temperature. Pure Pr2Zr2O7+/−delta as well as samples modified on the B-site with 5% Mn or 20% Ce show conductivities, which are lower than 2 x 10(-3) S/cm at 1000 degreesC in H-2/H2O atmospheres. Electronic p-type conductivity was indicated for these materials in oxygen/nitrogen mixtures. The electrically conducting pyrochlore solid solutions Gd2TiMoO7+/−delta and Gd2Ti0.6Mo1.4O7+/−delta were synthesised and investigated in 1% H-2/3% H2O/96% N-2. No formation of a new phase by reaction with YSZ was indicated after exposure to this atmosphere at 1000 degreesC for 1000 h. Pr2Sn2O7+/−delta modified with 5% indium on the B-site exhibited a conductivity in air of 6.5 x 10(-3) S/cm at 1000 degreesC. The pure material was found to decompose in mixtures of 9% H-2/3% H2O/88% N-2. (C) 2000 Elsevier Science B.V. All rights reserved.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Holtappels, P., Poulsen, F., Mogensen, M. B.
Pages: 675-679
Publication date: 2000
Peer-reviewed: Yes
High-temperature stability study of the oxygen-ion conductor La$_{0.9}$Sr$_{0.1}$Ga$_{0.8}$Mg$_{0.2}$O$_{3-x}$

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Tao, S., Poulsen, F., Meng, G., Toft Sørensen, O.
Pages: 1829-1833
Publication date: 2000
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Chemistry
Volume: 10
ISSN (Print): 0959-9428
Ratings:
Web of Science (2000): Indexed yes
Original language: English
Source: orbit
Source-ID: 301261
Research output: Contribution to journal » Journal article – Annual report year: 2000 » Research » peer-review

Impedance spectroscopy of piezoceramic multilayer components (poster)

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ringgaard, E., Poulsen, F., Mercurio, J., Wolny, W., Høj, J.
Publication date: 2000
Peer-reviewed: No
Source: orbit
Source-ID: 310382
Research output: Contribution to conference » Poster – Annual report year: 2000 » Research

Prospects and problems of dense oxygen permeable membranes
The prospects of using mixed ionic/electronic conducting ceramics for syngas production in a catalytic membrane reactor are analysed. Problems relating to limited thermodynamic stability and poor dimensional stability of candidate materials are addressed. The consequences for these problems, of flux improving measures like minimization of membrane thickness and minimization of the losses due to oxygen exchange over the membrane surfaces, are discussed. The analysis is conducted on two candidate materials: La$_{0.6}$Sr$_{0.4}$Co$_{0.2}$Fe$_{0.8}$O$_{3-delta}$ and SrFeCo$_{0.5}$O$_x$. Finally, experimental investigations of the dimensional stability of the latter material under reducing conditions are reported. (C) 2000 Elsevier Science B.V. All rights reserved.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hendriksen, P., Larsen, P., Mogensen, M. B., Poulsen, F., Wiik, K.
Pages: 283-295
Publication date: 2000
Peer-reviewed: Yes

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Journal: Catalysis Today
Volume: 56
Issue number: 1-3
ISSN (Print): 0920-5861
Ratings:
Scopus rating (2000): SJR 1.215 SNIP 1.545
Web of Science (2000): Indexed yes
Original language: English
DOIs:
10.1016/S0920-5861(99)00286-2
Source: orbit
Spectroscopic study of protons and deuterons in proton conducting perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Glerup, M., Berg, R., Poulsen, F.
Publication date: 2000
Peer-reviewed: No
Event: Abstract from 10th International Conference on Solid State Protonic Conductors, Montpellier, France.
Source: orbit
Source-ID: 301774

Speculations on the existence of hydride ions in proton conducting oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 2000
Peer-reviewed: No
Event: Abstract from 10th International Conference on Solid State Protonic Conductors, Montpellier, France.
Source: orbit
Source-ID: 301773

Structure, Raman spectra and defect chemistry modelling of conductive pyrochlore oxides

Mixed ionic-electronic conducting pyrochlore structure oxides, with Pr and Gd on the A site and Zr, Mn, Ce, Sn, In, Mo, and Ti on the B site, were characterised by X-ray powder diffraction and Raman spectroscopy. Mn and In have a solubility around x = 0.1-0.2 in Pr2Zr2-xMnxO7 and Pr2Sn2-xInxO7, respectively. In the series Pr2M2-xMxO7, where M = Sn, Zr and M' = In, Ce, we observe dopant-O-6 symmetrical stretch vibrations in addition to the host lattice modes. A defect model of a B site doped pyrochlore is developed with Pr3+ on the A site; Zr-B(x) (Zr4+), Ce-B' (Ce3+), Ce-B(x) (Ce4-) on the B site; O-O(x) and V-O on the O site, interstitial oxygens O-i", and delocalised electrons and electron holes. Four mass action law expressions govern such a model. The defect model can rationalise why home-valent doping, i.e. substitution of Zr(4+) by Ce(4+), can lead to an increase in ionic conductivity. The calculated Brouwer diagram for Pr2Zr1.6Ce0.4O7+δ-delta is shown. This composition has a transition from mixed ionic p-type to presumably pure ionic conduction around pO2(2) = 10(-7.5) atm. At pO2 < 10(-15) atm the material gradually changes into the n-type regime. Typical magnitudes are finally given for the four equilibrium constants, leading to cases of pure p-type, p- to n-type and pure electrolytic behaviour of doped pyrochlores. (C) 2000 Elsevier Science B.V. All rights reserved.
Conductivity of A- and B-site doped LaAlO$_3$, LaScO$_3$ and LaGaO$_3$ perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Larsen, D., Poulsen, F., Mogensen, M. B.
Pages: 293-303
Publication date: 1999

Host publication information
Title of host publication: Ionic and mixed conducting ceramics. Proceedings
Place of publication: Pennington, NJ
Publisher: The Electrochemical Society
Editors: Ramanarayan, T., Worrell, W., Tuller, H., Khandkar, A., Mogensen, M., Gopel, W.
ISBN (Print): 1-56677-177-3
Source: orbit
Source-ID: 299017
Research output: Chapter in Book/Report/Conference proceeding -> Article in proceedings – Annual report year: 1999
Research

Considerations of defect equilibria in high temperature proton-conducting cerates

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Bonanos, N., Poulsen, F.
Pages: 431-434
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Chemistry
Volume: 9
ISSN (Print): 0959-9428
Original language: English
Source: orbit
Source-ID: 300602
Research output: Contribution to journal -> Journal article – Annual report year: 1999
Research

Method for calculating ionic and electronic defect concentrations in fluorite structure oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 448-452
Publication date: 1999

Host publication information
Title of host publication: Ionic and mixed conducting ceramics. Proceedings
Place of publication: Pennington, NJ
Publisher: The Electrochemical Society
Editors: Ramanarayan, T., Worrell, W., Tuller, H., Khandkar, A., Mogensen, M., Gopel, W.
ISBN (Print): 1-56677-177-3
Source: orbit
Source-ID: 299016
Research output: Chapter in Book/Report/Conference proceeding -> Article in proceedings – Annual report year: 1999
Research
Method for calculating ionic and electronic defect concentrations in proton containing perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 115-121
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Journal of Solid State Chemistry
Volume: 143
ISSN (Print): 0022-4596
Scopus rating (1999): SJR 0.951 SNIP 1.234
Original language: English
Source: orbit
Source-ID: 300550
Research output: Contribution to journal › Journal article – Annual report year: 1999 › Research › peer-review

On-line demonstration of defect chemistry calculations on SOFC materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 189-198
Publication date: 1999

Host publication information
Title of host publication: Proceedings of IEA workshop
Place of publication: Paris
Publisher: International Energy Agency
Editor: Nisancioglu, K.
Source: orbit
Source-ID: 299692
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999 › Research

Oxygen transport in Co-substituted Sr$_4$Fe$_6$O$_{13}$

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Wiik, K.
Pages: 153-156
Publication date: 1999

Host publication information
Title of host publication: Proceedings of IEA workshop
Place of publication: Paris
Publisher: International Energy Agency
Editor: Nisancioglu, K.
Source: orbit
Source-ID: 299693
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999 › Research

Preparation of mixed conducting pyrochlores as SOFC anodes

General information
Problems of limited dimensional and thermodynamic stability in oxygen permeable membranes

Status of Danish solid oxide fuel cell R and D

Structural and electrical characterisation of SrCe_{1-x}Y_xO_{3-x/2}

The acceptor-doped perovskite proton conductor SrCe_{1-x}Y_xO_{3-x/2} (x = 0.025 to 0.20, xi = 3 - x/2) has been prepared and characterised using X-ray diffraction and AC impedance spectroscopy, and the effect of the yttrium dopant concentration on structure and electrical properties has been investigated. X-ray diffraction studies show a decrease in lattice volume with increasing yttrium content. Electrical conductivity studies have been made as a function of oxygen partial pressure, and at a partial pressure of water vapour of 0.007 atm. The total conductivity has been separated into different components by fitting procedures and regions of ionic and p-type conduction have been identified. At 800 degrees C and at the water vapour partial pressure of 0.007 atm, the ionic conductivity showed a maximum at a doping level of x = 0.10, reaching a value of 5 mS/cm. The conductivity component appearing at low oxygen partial pressure, which according to
recent studies may be regarded as protonic rather than n-type, decreased with doping, while the p-type component at high oxygen partial pressure increased. The relationship between the effect of doping on the conductivity and unit cell volume is discussed, (C) 1999 Elsevier Science B.V. All rights reserved.

Structure and thermal stability of nanostructured iron-doped zirconia prepared by high-energy ball milling
Fury stability cubic zirconia doped with iron oxide has been synthesized by high-energy ball milling from powder mixtures of monoclinic zirconia and hematite. It is found that the iron ions dissolved in cubic ZrO2 are in substitutional positions with a maximum solubility of approximately 18.5 mol% alpha-Fe2O3. The unit-cell volume of the cubic ZrO2 phase decreases with increasing iron content. During heating the cubic-to-tetragonal transition occurs at approximately 827 degrees C and the tetragonal-to-monoclinic transition seems to be absent at temperatures below 950 degrees C. During cooling the tetragonal-to-monoclinic transition occurs at 900-1100 degrees C.

Structure, Raman spectra and defect chemistry modeling of conductive pyrochlore oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Glerup, M., Holtappels, P.
Pages: 246-247
Publication date: 1999
**The influence of SiO₂ addition to 2MgO-Al₂O₃-3.3P₂O₅ glass**

*General information*
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Larsen, P., Berg, R., Poulsen, F.
Pages: 16-24
Publication date: 1999
Peer-reviewed: Yes

*Publication Information*
Journal: Journal of Non-Crystalline Solids
Volume: 244
ISSN (Print): 0022-3093
Ratings:
Scopus rating (1999): SJR 1.027 SNIP 0.963
Original language: English
DOIs: 10.1016/S0022-3093(98)00848-5
Source: orbit
Source-ID: 300584
Research output: Contribution to journal > Journal article – Annual report year: 1999 > Research > peer-review

*An in situ diffraction study of a solid oxide fuel cell system*
The design of a synchrotron diffraction experiment on a working SOFC air-electrode is outlined. A large number of diffraction data sets were collected successfully from LSM/YSZ/Ag cells under different polarization states at 850 degrees C. Systematic changes are observed in lattice parameters and FWHM's for the LSM phase when the cell is polarized. The peak positions for the YSZ electrode are unchanged throughout the entire experiment. This is the first experimental evidence that oxygen stoichiometry in LSM is strongly influenced by the electrochemical reactions which take place. The cell parameters increase under reducing conditions, due to a decrease in the oxygen content of the LSM. All observed changes seem to be reversible.

*General information*
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Sörby, L., Poulsen, F., Poulsen, H., Garbe, S., Thomas, J.
Pages: 408-413
Publication date: 1998

*Host publication information*
Title of host publication: Proceedings of 5th European Powder Diffraction Conference
Volume: 278-281
Publisher: Transtec Publications LTD
ISBN (Print): 0-87849-807-9
(Materials Science Forum).
Source: orbit
Source-ID: 298447
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 1998 > Research > peer-review

*In plane conductivity of improved Ni-cermet anodes*

*General information*
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Kindermann, L., Poulsen, F., Bagger, C.
Pages: 133-143
Publication date: 1998

Host publication information
Title of host publication: 3. European solid oxide fuel cell forum
Place of publication: Oberrohrdorf (CH)
Publisher: European Fuel Cell Forum
Editor: Stevens, P.
ISBN (Print): 3-905592-00-2
Source: orbit
Source-ID: 298247
Research output: Chapter in Book/Report/Conference proceeding → Article in proceedings – Annual report year: 1998 → Research

Measurements and modelling of mixed conduction in oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 35-36
Publication date: 1998
Peer-reviewed: No

Publication information
Journal: Tidsskrift for Dansk Keramisk Selskab
Volume: 1
Issue number: 2
Original language: English
Source: orbit
Source-ID: 298994
Research output: Contribution to journal → Journal article – Annual report year: 1999 → Research

Preparation of pyrochlores as novel anode materials in SOFC

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Holtappels, P., Poulsen, F., Mogensen, M.
Publication date: 1998
Peer-reviewed: No
Event: Abstract from 11th IEA SOFC workshop, Arnhem, Netherlands.
Source: orbit
Source-ID: 297931
Research output: Contribution to conference → Conference abstract for conference – Annual report year: 1998 → Research

Prospects and problems of dense oxygen permeable ceramic membranes

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hendriksen, P., Larsen, P., Mogensen, M. B., Poulsen, F.
Publication date: 1998

Host publication information
Title of host publication: 3. International conference on catalysis in membrane reactors. Abstracts
Place of publication: Copenhagen
Publisher: Danish Society of Engineers, IDA
Source: orbit
Source-ID: 298004
Research output: Chapter in Book/Report/Conference proceeding → Conference abstract in proceedings – Annual report year: 1998 → Research
Synthesis and properties of La-Sr-Mn-Fe-O based perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Kindermann, L., Poulsen, F., Larsen, P., Nickel, H., Hilpert, K.
Pages: 123-132
Publication date: 1998

Host publication information
Title of host publication: 3. European solid oxide fuel cell forum
Place of publication: Oberrohrdorf (CH)
Publisher: European Fuel Cell Forum
Editor: Stevens, P.
ISBN (Print): 3-905592-00-2
Source: orbit
Source-ID: 298246
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1998 – Research

An in-situ diffraction study of a solid oxide fuel cell system

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Sörby, L., Poulsen, F., Poulsen, H., Garbe, S.
Publication date: 1997
Peer-reviewed: No
Event: Abstract from 5th European Powder Diffraction Conference, Parma, Italy.
Source: orbit
Source-ID: 295934
Research output: Contribution to conference – Conference abstract for conference – Annual report year: 1997 – Research

Applications of high-energy synchrotron radiation for structural studies of polycrystalline materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Pages: 147-154
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: Journal of Synchrotron Radiation
Volume: 4
ISSN (Print): 0909-0495
Original language: English
Source: orbit
Source-ID: 297074

Chemical compatibility of (La_{0.6}Ca_{0.4})_{x}Fe_{0.8}Mn_{0.2}O_{3} with yttria-stabilized zirconia

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Pages: 717-720
Publication date: 1997
Peer-reviewed: Yes
Conductivity of A- and B-site doped LaAlO₃, LaScO₃ and LaGaO₃ perovskites

Correlation of gas sensitive properties with Fe₂O₃-SnO₂ ceramic microstructure prepared by high energy ball milling

Correlation of gas sensitive properties with microstructure of Fe₂O₃-SnO₂ ceramics prepared by high energy ball milling

Experimental and theoretical methods in fuel cell research
High temperature fuel cells: Status and spin-offs

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 1997
Peer-reviewed: No
Source: orbit
Source-ID: 295936
Research output: Contribution to conference > Conference abstract for conference – Annual report year: 1997 > Research

In-situ studies of air electrodes in solid oxide fuel cells at 850 deg.C using synchrotron diffraction

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Sörby, L., Poulsen, H., Garbe, S.
Pages: 84-87
Publication date: 1997
Host publication information
Title of host publication: Materials and processes. 10th SOFC workshop. vol. 1
Publisher: International Energy Agency
Editors: McEvoy, A., Nisancioglu, K.
Source: orbit
Source-ID: 295870
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 1997 > Research

Mechanical alloying of an immiscible α-Fe2O3-SnO2 ceramic

A solid solution of about 6 mol% SnO2 in α-Fe2O3 has been prepared by mechanical alloying of α-Fe2O3 and SnO2 powder blends. This result demonstrates that high energy ball milling can be used to prepare metastable oxide solid solutions with an extended range of compositions in the immiscible ceramic oxide system. X-ray diffraction and Mossbauer spectroscopy investigations show that mechanical milling of α-Fe2O3 and SnO2 involves alloying on an atomic scale and that true solid solution formation occurs. We suggest that the high defect concentration and the chemical enthalpy of Fe3+-O2--Sn4+ interfaces between nanostructured α-Fe2O3 and SnO2 regions may serve as a driving force for the formation of a solid solution in the immiscible ceramic system.

General information
Publication status: Published
Organisations: Department of Physics, Quantum Physics and Information Technology, Department of Chemistry, Electroceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, The Open University, INM Institut für Neue Materialien
Contributors: Jiang, J., Lin, R., Merup, S., Nielsen, K., Poulsen, F. W., Berry, F., Clasen, R.
Pages: 11-14
Publication date: 1997
Peer-reviewed: Yes
Redetermination of the crystal structure of $\text{Al}_2\text{Br}_6$. A comparison of three methods

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Berg, R., Nielsen, K., Poulsen, F.
Pages: 442-448
Publication date: 1997
Peer-reviewed: Yes

**Publication information**
Volume: 51
Original language: English
Source: orbit
Source-ID: 295932
Research output: Contribution to journal › Journal article – Annual report year: 1996 › Research › peer-review

Defect chemistry in perovskites

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 1996
Peer-reviewed: No
Source: orbit
Source-ID: 294679
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 1996 › Research

Electrical characterisation of $\text{SrCe}_{0.95}\text{Y}_{0.05}\text{O}_{3-\delta}$

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Hansen, J., Bonanos, N., Poulsen, F., Mogensen, M. B.
Pages: 161-166
Publication date: 1996

**Host publication information**
Title of host publication: High temperature electrochemistry: Ceramics and metals. Proceedings
Place of publication: Roskilde
Publisher: Risø National Laboratory
Editors: Poulsen, F., Bonanos, N., Linderoth, S., Mogensen, M., Zachau-Christiansen, B.
ISBN (Print): 87-550-2199-9
Source: orbit
Source-ID: 295226
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1996 › Research

Electric conductivity of $\text{La}_{1-x}\text{Sr}_x\text{Fe}_{1-y}\text{Mn}_y\text{O}_3$ materials

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Raman spectroscopic characterization of $\text{ZrO}_2$ and yttrium stabilized zirconias

Current literature on the analysis of vibrational spectra of monoclinic, tetragonal and cubic zirconias is reviewed. The selection rules based on simple factor group analysis are not obeyed for the structurally disordered tetragonal and cubic materials. The interpretation is thus not straightforward. The spectral features of the Raman spectra do furthermore not only depend on the phase composition, but also depend on the frequency of the excitation, temperature of experiment and texture/orientation of zirconia crystallites under investigation. These effects are illustrated by Raman spectra obtained on $\text{ZrO}_2$ and YSZ (Yttrium Stabilized Zirconias) in the range 8, 12 and 18 mol% Y2O3 and 4 mol% Yb2O3 + 4 mol% Y2O3. The peak positions in the spectra of 8 mol% YSZ (Viking) are lowered by up to 20 cm$^{-1}$ upon heating to 700 oC. Intense fluorescence/fluorescence bands at 1000-1600 cm$^{-1}$ were observed in clear single crystals and may tentatively be assigned to rare earth impurities (e.g. Er, Tb, Ho, Eu), although other causes are possible. Upon cooling to liquid temperature these bands grow in intensity, ruling out their assignment as vibrational over- or combination tones. The low frequency modes at <800 cm$^{-1}$, however, are reduced in intensity, only the F2g mode survives.
Short term structural changes in NiO/YSZ electrodes upon reduction

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Aaberg, R., Tunold, R., Poulsen, F., Bonanos, N.
Pages: 363-372
Publication date: 1996

Host publication information
Title of host publication: Second European solid oxide fuel cell forum. Proceedings. Vol. 1
Place of publication: Oberrohrdorf (CH)
Publisher: European SOFC Forum
Editor: Thorstensen, B.
Source: orbit
Source-ID: 294820

Thermoelectric power and electrical conductivity of strontium-doped lanthanum manganite
Thermoelectric power and electrical conductivity of pure and 5, 10 and 20% strontium-doped lanthanum manganite are determined as function of temperature in air and of P-O2 at 1000 degrees C. At high temperatures the thermoelectric power is negative. Both thermoelectric power and conductivity are found to be nearly independent of doping at high temperatures, but not at low. This can be explained if it is assumed that Mn3+ disproportionates into Mn2+ and Mn4+. In reducing atmospheres the thermoelectric power is found to be only slightly dependent on P-O2, which also might be explained by the disproportionation reaction.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Poulsen, F.
Pages: 1173-1178
Publication date: 1996
Peer-reviewed: No

Publication information
Journal: Solid State Ionics
Volume: 86/88
ISSN (Print): 0167-2738
Original language: English
DOIs: 10.1016/0167-2738(96)00283-4
Source: orbit
Source-ID: 294812

Thermoelectric power of doped cerium oxide

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Poulsen, F.
Pages: 589-599
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Journal of Physics and Chemistry of Solids
Volume: 57
ISSN (Print): 0022-3697
Original language: English
Chemical compatibility of \( (\text{La}_6\text{Ca}_{0.4})_x\text{Fe}_{0.8}\text{M}_{0.2}\text{O}_3 \) \((x=1,0.9; \text{M}=\text{Cr},\text{Mn},\text{Co},\text{Ni})\) with YSZ

**General information**
- **Publication status:** Published
- **Organisations:** Risø National Laboratory for Sustainable Energy
- **Contributors:** Kindermann, L., Das, D., Weiss, R., Nickel, H., Hilpert, K., Poulsen, F.
- **Publication date:** 1995
- **Peer-reviewed:** No
- **Event:** Abstract from 4th International symposium on solid oxide fuel cells (SOFC-IV), Yokohama, Japan.

Current induced phase change in strontium doped lanthanum manganite: A synchrotron study of a perovskite solid oxide fuel cell electrode at 1000 deg. C

**General information**
- **Publication status:** Published
- **Organisations:** Risø National Laboratory for Sustainable Energy
- **Contributors:** Poulsen, F., Poulsen, H., Garbe, S., Sörby, L.
- **Publication date:** 1995
- **Peer-reviewed:** No
- **Event:** Abstract from Workshop on defect and transport properties in perovskites, Geilo, Norway.

Defect equilibrium calculations in high temperature proton conductors

**General information**
- **Publication status:** Published
- **Organisations:** Risø National Laboratory for Sustainable Energy
- **Contributors:** Bonanos, N., Poulsen, F., Mogensen, G.
- **Publication date:** 1995
- **Peer-reviewed:** No
- **Event:** Abstract from Conference on ceramic oxygen ion conductors and their technological applications, Ambleside, Cumbria (GB), 19-21 Jul, .

Observation and modelling of inductive effects in four-terminal impedance measurements

**General information**
- **Publication status:** Published
- **Organisations:** Risø National Laboratory for Sustainable Energy
- **Contributors:** Poulsen, F., Bonanos, N.
- **Publication date:** 1995
- **Peer-reviewed:** No
- **Event:** Abstract from Dansk Elektrokemisk Forening, Lyngby, Denmark.

Observation and modelling of inductive effects in four-terminal impedance measurements on solid electrolytes

**General information**
- **Publication status:** Published
Redetermination of the crystal structure of $\text{Al}_2\text{Br}_6$

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Berg, R., Nielsen, K., Poulsen, F.
Pages: 381-385
Publication date: 1995

**Host publication information**
Title of host publication: International Harald A. Øye Symposium. Proceedings
Place of publication: Trondheim
Publisher: Norwegian Institute of Technology. Institute of Organic Chemistry
Editors: Sarlø, M., Østvold, T., Huglen, R.
Source: orbit
Source-ID: 292979

Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1995 › Research

Seebeck coefficient of strontium doped lanthanum manganites

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Poulsen, F.
Publication date: 1995

**Publication information**
Journal: Journal of The Electrochemical Society
Volume: 142
ISSN (Print): 0013-4651
Original language: English
Source: orbit
Source-ID: 293196

Research output: Contribution to journal › Journal article – Annual report year: 1995 › Research › peer-review

Thermoelectric power of $\text{ErAl(Mg)}\text{O}_{3-\delta}$ and $\text{LaAl(Mg)}\text{O}_{3-\delta}$

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Ranlev, J., Poulsen, F.
Pages: 4230-4234
Publication date: 1995
Peer-reviewed: Yes

**Publication information**
Journal: Journal of The Electrochemical Society
Volume: 142
ISSN (Print): 0013-4651
Original language: English
Source: orbit
Source-ID: 293196

Research output: Contribution to journal › Journal article – Annual report year: 1995 › Research › peer-review

Thermoelectric power of stabilized zirconia

**General information**
2nd Nordic symposium on high temperature fuel cells. Proceedings

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Number of pages: 275
Publication date: 1994

Conductivity and Seebeck measurements on strontium ferrates

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Lauvstad, G., Tunold, R.
Pages: 47-53
Publication date: 1994

Criteria for prediction of high oxide ion conductivity in perovskite oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ranlav, J., Bonanos, N., Poulsen, F., Mogensen, M. B.
Pages: 219-222
IEA agreement for a programme of research, development and demonstrations of solid oxide fuel cells

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Pages: 93-102
Publication date: 1994

Host publication information
Title of host publication: First European solid oxide fuel cell forum. Proceedings. Vol. 1
Place of publication: Baden
Publisher: European SOFC Forum Secretariat
Editor: Bossel, U.
Source: orbit
Source-ID: 291954

Influence of copper-doping and iron-doping in cubic yttria-stabilized zirconia

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Hartmanova, M., Poulsen, F., Hanic, F., Putyera, K., Tunega, D., Urusovskaya, A., Oreshnikova, T.
Pages: 2152-2158
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Science
Volume: 29
ISSN (Print): 0022-2461
Original language: English
Source: orbit
Source-ID: 291790

New experiments in fuel cell research

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 15-20
Publication date: 1994

Host publication information
Title of host publication: 2nd Nordic symposium on high temperature fuel cells. Proceedings
Place of publication: Ås
Publisher: Nordisk Energiforskningsprogram. Energiforskningen
Editors: Norby, T., Poulsen, F. (Nordisk energiforskningssamarbejde).
Source: orbit
Source-ID: 291983

Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1994 › Research
On the thermoelectric power of a mixed ionic-electronic conductor

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Ranløv, J., Poulsen, F.
Pages: 221-226
Publication date: 1994

Host publication information
Title of host publication: 2nd Nordic symposium on high temperature fuel cells. Proceedings
Place of publication: Ås
Publisher: Nordisk Energiforskningsprogram. Energiforskningen
Editors: Norby, T., Poulsen, F.
(Nordisk energiforskningssamarbejde).
Source: orbit
Source-ID: 291996
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1994 – Research

Thermoelectric power of rare earth aluminates

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Ranløv, J., Poulsen, F.
Pages: 598-607
Publication date: 1994

Host publication information
Title of host publication: Ionic and mixed conducting ceramics. Proceedings
Place of publication: Pennington, NJ
Publisher: The Electrochemical Society
Editors: Ramanarayanan, T., Worrell, W., Tuller, H.
(High Temperature Materials Division Proceedings Volume, 94-12).
Source: orbit
Source-ID: 291796
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1994 – Research

Thermoelectric power of YSZ

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ahlgren, E., Poulsen, F.
Pages: 528-532
Publication date: 1994

Host publication information
Title of host publication: Solid state ionics-93. Part 1
Place of publication: Amsterdam
Publisher: North-Holland
Editors: Boukamp, B., Bouwmeester, H., Burggraaf, A., Put, P. V. D., Schoonman, J.
(Solid State Ionics, 70/71).
Source: orbit
Source-ID: 292049
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1994 – Research

Abstracts of Nordisk Ministerråds workshop on high temperature electrode materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Number of pages: 193
Publication date: 1993

**Publication information**
Place of publication: Roskilde
Publisher: Risø National Laboratory. Materials Department
Original language: English
Source: orbit
Source-ID: 290473
Research output: Book/Report › Book – Annual report year: 1993 › Research › peer-review

**Comment on 'The characterization of doped CeO2 electrodes in solid oxide fuel cells' by B.G. Pound**
**Electrode tests and ac impedance measurements presented by Pound on Ni, Co and Mn doped CeO2 are reviewed. We find that the stability of solid solutions in the systems of NiO-CeO2 and CoO-CeO2 are improbable and that therefore the interpretation of ac impedance data and electrode tests should be in terms of two-phase systems.**

**Conductivity and seebeck measurements on strontium ferrates**

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ranløv, J., Poulsen, F., Mogensen, M. B.
Pages: 277-279
Publication date: 1993
Peer-reviewed: No

**Publication information**
Journal: Solid State Ionics
Volume: 61
Issue number: 4
ISSN (Print): 0167-2738
Original language: English
DOIs: 10.1016/0167-2738(93)90392-G
Source: orbit
Source-ID: 290809
Research output: Contribution to journal › Journal article – Annual report year: 1993 › Research

**Control of electrical and electrochemical measurements on SOFC materials**

**General information**
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Østergård, M., Lindegaard, T., Mogensen, M. B., Poulsen, F., Malmgren-Hansen, B.
Pages: 507-514
Publication date: 1993

**Host publication information**
Title of host publication: High temperature electrochemical behaviour of fast ion and mixed conductors
Place of publication: Roskilde
Publisher: Risø National Laboratory
Electrical characterisation of bad contacts

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 1993
Peer-reviewed: No
Source: orbit
Source-ID: 291152
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 1993

High temperature electrochemical behaviour of fast ion and mixed conductors

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Number of pages: 518
Publication date: 1993

Publication information
Place of publication: Roskilde
Publisher: Risø National Laboratory
ISBN (Print): 87-550-1919-6
Original language: English
Source: orbit
Source-ID: 290541
Research output: Contribution to conference – Conference abstract for conference – Annual report year: 1993

Mixed ionic and electronic conductivity of rare earth aluminates

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Ranløv, J., Mogensen, M. B., Poulsen, F.
Pages: 389-396
Publication date: 1993

Host publication information
Title of host publication: High temperature electrochemical behaviour of fast ion and mixed conductors
Place of publication: Roskilde
Publisher: Risø National Laboratory
Editors: Poulsen, F., Bentzen, J., Jacobsen, T., Skou, E., Østergård, M.
ISBN (Print): 87-550-1919-6
Source: orbit
Source-ID: 291139
Research output: Book/Report – Book – Annual report year: 1993

Review of thermoelectric power of doped chromites and manganites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Admittance spectroscopy of SOFC materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 81-90
Publication date: 1992

Host publication information
Title of host publication: 1. Nordic symposium on materials for high temperature fuel cells
Place of publication: Stockholm
Publisher: Royal Institute of Technology
Editor: Bergman, B.
ISBN (Print): 91-7170-081-1
Source: orbit
Source-ID: 290327

Aspects of fuel cells

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 9-18
Publication date: 1992

Host publication information
Title of host publication: Polymer electrolytes for fuel cells
Place of publication: Helsinki
Publisher: University of Helsinki. Department of Polymer Chemistry
Editor: Sundholm, F.
(Nordisk energiforskningsamarbejde).
Source: orbit
Source-ID: 289693

Electrical characterisation of mixed conduction in oxides

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 115-118
Publication date: 1992

Host publication information
Title of host publication: 1. Nordic symposium on materials for high temperature fuel cells
Place of publication: Stockholm
Publisher: Royal Institute of Technology
Editor: Bergman, B.
ISBN (Print): 91-7170-081-1
Source: orbit
Source-ID: 290329
Exact solutions to Kröger-Vink diagrams for perovskites

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 1992
Peer-reviewed: No
Event: Abstract from NMR-workshop on high temperature electrode materials, Roskilde (DK), 26 Oct, .
Source: orbit
Source-ID: 289692
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 1992 › Research

Fabrication of oxide powders by the glycine/nitrate method

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Ranløv, J., Holt, A.
Publication date: 1992
Peer-reviewed: No
Source: orbit
Source-ID: 289629
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 1992 › Research

Lithium insertion in sputtered vanadium oxide film
Vanadium oxide films have been prepared by RF-sputtering using an oxygen containing sputter ps and a V2O5 target. The main component of these films is orthorhombic V2O5 with poor crystallinity and a tendency for ordering of the crystallites with the c-direction parallel to the substrate. All films were oxygen deficient compared to V2O5. Films prepared in pure argon were reduced to V(4) or lower. The vanadium oxide films were tested in solid-state lithium cells. Films sputtered in oxygen showed electrochemical properties similar to crystalline V2O5. The main differences are a decreased capacity above 3.0 V, showing that V is partially reduced, and a broadening of the capacity peaks, showing that the crystallinity of these films is rather low. The film sputtered in argon behaved differently, discharging at a very low potential, 1.9 V versus Li, in the first cycle. In subsequent cycles the average insertion potential was increased due to a structural distortion of the host.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: West, K., Zachau-Christiansen, B., Skaarup, S., Poulsen, F.
Pages: 41-47
Publication date: 1992
Peer-reviewed: No
Publication information
Journal: Solid State Ionics
Volume: 57
Issue number: 1-2
ISSN (Print): 0167-2738
Original language: English
DoIs: 10.1016/0167-2738(92)90062-T
Source: orbit
Source-ID: 290016
Research output: Contribution to journal › Journal article – Annual report year: 1992 › Research

Phase relations and conductivity of Sr-zirconates and La-zirconates
The formation of the strontium zirconates SrZrO3, Sr4Zr3O10, Sr3Zr2O7 and Sr2ZrO4, and of the lanthanum zirconates La2Zr2O7 and La2-\text{x}YZr2O7 at 1450-degrees-C was investigated by x-ray powder diffraction and DTA. Three different routes of synthesis were tested. In the Sr-zirconate system, single phase orthorhombic SrZrO3 and somewhat impure, tetragonal Sr2ZrO4 were observed, whereas the formation of ordered Ruddlesden-Popper phases, Sm2Zr2-103n-2, where n = 4 and 3, could not be verified. The conductivity of La2Zr2O7 was 3.7 X 10(-6) S/cm at 750-degrees-C and 3.8 x 10(-5)
S/cm at 1000-degrees-C. The conductivity of the Sr-zirconates increases with increasing Sr/Zr ratio. Samples with a nominal composition corresponding to Sr2ZrO4 have a conductivity of 7.5 x 10(-5) and 5.9 x 10(-4) S/cm at 750 and 1000-degrees-C, respectively. For all samples one observes low activation energies for ionic conduction (0.5-0.65 eV). Formation of pyrochlore structure La2-xYzr2O7 from YSZ and La2O3 at 1450-degrees-C was demonstrated.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Vanderpuil, N.
Pages: 777-783
Publication date: 1992
Peer-reviewed: No

Publication information
Journal: Solid State Ionics
Volume: 53
ISSN (Print): 0167-2738
Original language: English
Source: orbit
Source-ID: 290017
Research output: Contribution to journal › Journal article – Annual report year: 1992 › Research

Van der Pauw- and conventional 2-point conductivity measurements on YSZ-plates

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Buitink, P., Malmgren-Hansen, B.
Pages: 755-767
Publication date: 1991

Host publication information
Title of host publication: Proceedings of the 2. International symposium on solid oxide fuel cells
Volume: EUR-13564
Editors: Grosz, F., Zegers, P., Singhal, S., Yamamoto, O.
Source: orbit
Source-ID: 289111
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1991 › Research

Automatic performance of electrochemical experiments

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Malmgren-Hansen, B., Mogensen, M. B., Poulsen, F.
Publication date: 1990

Host publication information
Title of host publication: SCAN-ELCHEM-90. Abstracts
Place of publication: Copenhagen
Publisher: Danish Electrochemical Society
Editors: Hammerich, O., Jensen, O., Ulstrup, J.
Source: orbit
Source-ID: 288540
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1990 › Research

En miljøvenlig lille celle

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Mogensen, M. B., Poulsen, F.
First Danish solid oxide fuel cell tests

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Kindl, B., Mogensen, M. B., Poulsen, F. W.
Publication date: 1990

Host publication information
Title of host publication: SCAN-ELCHEM-90. Abstracts
Place of publication: Copenhagen
Publisher: Danish Electrochemical Society
Editors: Hammerich, O., Jensen, O., Ulstrup, J.
Source-ID: 288538
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 1990 – Research

Oxygen ion conduction in ternary zirconia mixtures: Effects of SrO on MgSZ

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Bilde-Sørensen, J., Ghanbari-Ahari, K., Knab, G., Hartmanová, M.
Pages: 947-951
Publication date: 1990
Peer-reviewed: No

Publication information
Journal: Solid State Ionics
Volume: 40/41
ISSN (Print): 0167-2738
Original language: English
DOIs: 10.1016/0167-2738(90)90160-S
Source-ID: 288612
Research output: Contribution to journal – Journal article – Annual report year: 1990 – Research

Techniques for the Danish solid oxide fuel cell project

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Number of pages: 58
Publication date: 1990

Publication information
ISBN (Print): 87-550-1510-7
Original language: English
Conductivity of Thin YSZ-Materials

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F., Bentzen, J., Bilde-Sørensen, J.
Pages: 93-100
Publication date: 1989

Host publication information
Title of host publication: Proceedings of SOFC-Nagoya
Place of publication: Nagoya
Publisher: SOFC Society of Japan
Source: orbit
Source-ID: 288118
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1989 – Research

Differences between Japanese and Danish Alternative Energy Research. (in Japanese)

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 11-26
Publication date: 1989

Host publication information
Title of host publication: Differences between Japanese and Danish Alternative Energy Research. (in Japanese)
Volume: NEDO-P-8842
Source: orbit
Source-ID: 288097

Experiments on Palladium- and Titanium-Deuterium Systems with Reference to Studies on Cold Fusion
The work performed at Risø in connection with the claims of »cold fusion« is summarised in this report. The main purpose of the whole experiment was to analyse if structural anomalies of deuterated metals could support the occurrence of fusion processes in such systems by x-ray and neutron powder diffraction methods. Two types of systems were investigated. The first one was an electrolytic cell with palladium as electrode. No anomalous properties in the composition and positions of deuterium were found in this case. The other one was a titanium-deuterium gas system which was studied in order to reproduce the »Frascati experiment«. However, no neutrons above the background level were observed in spite of the very sensitive detector system. By neutron diffraction of this system a 70% titanium-dideuterium phase was found.

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy, Nano-Microstructures in Materials, Materials Research Division, Plasma Physics and Technology Programme, Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division
Contributors: Als-Nielsen, J. A., Andersen, N. H., Clausen, K., Michelsen, P., Poulsen, F. W.
Number of pages: 12
Publication date: 1989

Publication information
Place of publication: Roskilde
Publisher: Risø National Laboratory
ISBN (Print): 87-550-1556-5
Original language: English
Impressions of the Japanese Sunshine and Moonlight Projects

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Number of pages: 28
Publication date: 1989

Publication information
ISBN (Print): 87-550-1504-2
Original language: English
Keywords: Risø-M-2774

Proton Conduction in Solids

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Pages: 166-200
Publication date: 1989

Host publication information
Title of host publication: High Conductivity Solid Ionic Conductors. Recent Trends and Applications
Place of publication: Singapore
Publisher: World Scientific
Editor: Takahashi, T.
Source: orbit
Source-ID: 288079

Thin Tape Cast Zirconia for Solid Oxide Fuel Cells

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Bentzen, J., Bilde-Sørensen, J., Kindl, B., Paulsen, H., Poulsen, F.
Pages: 149-157
Publication date: 1989

Host publication information
Title of host publication: New Materials and Processes. Proceedings
Place of publication: Copenhagen
Publisher: Danish Society for Materials Testing and Research
Editors: Hansson, I., Lilholt, H.
ISBN (Print): 87-983211-0-2
Source: orbit
Source-ID: 288111

The Effect of Different Internal Surfaces in Composite Lithium Electrolytes

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F.
Publication date: 1987
Peer-reviewed: Yes

Publication information
Journal: Journal of Power Sources
ISSN (Print): 0378-7753
Original language: English
Source: orbit
Source-ID: 287363
Research output: Contribution to journal › Journal article – Annual report year: 1987 › Research › peer-review

Composite Li-conducting Solid Electrolytes

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Number of pages: 94
Publication date: 1986

Publication information
Original language: English
(Risø-M; No. 2540).
Keywords: Risø-M-2540
Source: orbit
Source-ID: 279503
Research output: Book/Report › Report – Annual report year: 1986 › Research

Prospektering af faststof ionledere

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Pages: 14-15
Publication date: 1986

Host publication information
Title of host publication: Generel og Anvendt Elektrokemi i Danmark, Symposium, DTH, Lyngby, 9 april 1986
Publisher: Dansk Elektrokemisk Forening, Selskabet for Analytisk Kemi
Source: orbit
Source-ID: 279502
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1986 › Research › peer-review

Raman spectrum of the solid electrolytes LiI·H2O and LiI·D2O
The Raman spectra of cubic LiI·H2O and LiI·D2O have been revised. The spectra reveal only internal and librational modes of H2O (D2O). The isotopic ratios vH/vD, are in the range 1.33-1.78

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Risøs metoder til studier af faststofelektrolytter

General information
Publication status: Published
Organisations: Nano-Microstructures in Materials, Materials Research Division, Risø National Laboratory for Sustainable Energy, Electrochemistry, Fuel Cells and Solid State Chemistry Division, Microstructures and Interfaces
Contributors: Andersen, N. H., Bentzen, J. J., Mogensen, M. B., Poulsen, F. W., Sørensen, O. T.
Pages: 16-17
Publication date: 1986

Host publication information
Title of host publication: Generel og Anvendt Elektrokemi i Danmark, Symposium, DTH, Lyngby, 9 april 1986
Publisher: Dansk Elektrokemisk Forening, Selskabet for Analytisk Kemi
Source-ID: 279018

Tynde fastelektrotyltag på lithiumelektroder

General information
Publication status: Published
Organisations: Electrochemistry, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Microstructures and Interfaces
Contributors: Mogensen, M. B., Poulsen, F. W.
Pages: 26-27
Publication date: 1986

Host publication information
Title of host publication: Generel og Anvendt Elektrokemi i Danmark, Symposium, DTH, Lyngby, 9 april 1986
Place of publication: Lyngby, Denmark
Publisher: Dansk Elektrokemisk Forening, Selskabet for Analytisk Kemi
Source-ID: 279422


General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Hooper, A. (ed.), Poulsen, F. W., Andersen, N. H.
Number of pages: 184
Publication date: 1985
Ionic conductivity of solid and molten lithium thiocyanate and its hydrate

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Pages: 290-292
Publication date: 1985
Peer-reviewed: No

Publication information
Journal: Acta chemica Scandinavica. Series A. Physical and inorganic chemistry
Volume: 39
Issue number: 4
ISSN (Print): 0302-4377
Original language: English
Source: orbit
Source-ID: 279208
Research output: Contribution to journal › Journal article – Annual report year: 1985 › Research


General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Number of pages: 491
Publication date: 1985

Publication information
Place of publication: Roskilde
Publisher: Risø National Laboratory
Original language: English
Source: orbit
Source-ID: 279306
Research output: Book/Report › Book – Annual report year: 1985 › Research › peer-review

Conductivity, Structure and Specific Heat of LiBiO_2

General information
Publication status: Published
Organisations: Nano-Microstructures in Materials, Materials Research Division, Risø National Laboratory for Sustainable Energy, Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division
Contributors: Andersen, N. H., Poulsen, F. W., Eichinger, G.
Pages: 287-290
Publication date: 1983

Host publication information
Place of publication: Amsterdam
Publisher: Elsevier
Editor: Metselaar, R.
ISBN (Print): 0444421475
(Studies in Inorganic Chemistry; No. 3).
Source: orbit
Source-ID: 281731
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1983 › Research
NMR Studies of Lithium Iodide Based Solid Electrolytes
In mixture of LiI with γAl2O3 the ionic conductivity is found to increase by up to three orders of magnitude over pure LiI. NMR measurements of 7Li relaxation times were performed on both anhydrous LiI and a mixture of LiI with 30m/o γAl2O3. The relaxation is found to be purely dipolar in origin for the pure halide with correlation times consistent with conductivity data. However two relaxation rates are found in the composite material which indicate that 50% of the 7Li ions are in a radically different environment.

General information
Publication status: Published
Organisations: Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Dupree, R., Howells, R. J., Hooper, A., Poulsen, F. W.
Pages: 131-134
Publication date: 1983
Peer-reviewed: Yes

Publication information
Journal: Solid State Ionics
Volume: 9-10
ISSN (Print): 0167-2738
Original language: English
DOIs: 10.1016/0167-2738(83)90221-7
Source: orbit
Source-ID: 281632
Research output: Contribution to journal › Journal article – Annual report year: 1983 › Research › peer-review

Properties of LiI-Alumina Composite Electrolytes

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Nano-Microstructures in Materials, Materials Research Division
Contributors: Poulsen, F. W., Andersen, N. H., Kindl, B., Schoonman, J.
Pages: 119-122
Publication date: 1983
Peer-reviewed: Yes

Publication information
Journal: Solid State Ionics
Volume: 9-10
ISSN (Print): 0167-2738
Original language: English
Source: orbit
Source-ID: 281987
Research output: Contribution to journal › Journal article – Annual report year: 1983 › Research › peer-review

Neutron Scattering Studies of the Ionic Conductor LiI D2O
The structural properties of the ionic conductor LiI D2O have been studied by neutron scattering. The cubic room temperature α-phase, Pm3m, is disordered both with respect to the occupation of the Li+-positions and to the orientations of the water molecules. A first order phase transition from the α-phase to a new orthorhombic β-phase, P21am or Pmam, has been found at -54°C. The structural parameters of the β-phase have been determined by the Rietveld method based on powder diffraction data. The β-phase is found to have an antiferroelectric ordering of the water molecules and a spatial ordering of the Li+-sites. Evidence for short range order is found in the diffuse elastic scattering in the α-phase and the implications for the ionic conductivity are discussed.

General information
Publication status: Published
Organisations: Risø National Laboratory, Risø National Laboratory for Sustainable Energy
Contributors: Andersen, N. H., Kjems, J., Poulsen, F. W.
Pages: 780-784
Publication date: 1982
Peer-reviewed: Yes
Configurational Model for Conductivity of Stabilized Fluorite Structure Oxides

The formalism developed here furnishes means by which ionic configurations, solid solution limits, and conductivity mechanisms in doped fluorite structures can be described. The present model differs markedly from previous models but reproduces qualitatively reality. The analysis reported is for the case of a MO2 oxide doped with a divalent oxide MeO.
An introduction to proton conduction in solids
Proton conducting solids have been studied intensively in recent years due to their potential use as ion conducting separators in efficient fuel cells for electricity generation.

This report describes fuel cell - and other possible applications of solid proton conductors. The best performing materials known today are listed. Typical synthetic routes and some models for proton transport in solids are discussed. Hints to future research are given.

The literature collected for this report covers mainly the period 1974 - 1980.
Behaviour of Hard and Soft Ions in Solid Electrolytes

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Number of pages: 373
Pages: 229-233
Publication date: 1980

Host publication information
Title of host publication: Materials for Advanced Batteries: Proceedings of a NATO Symposium
Place of publication: New York
Publisher: Plenum Publishing Corporation
ISBN (Print): 0306405644

Raman Study of New Addition Compounds of SC14

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Poulsen, F. W.
Pages: 355-360
Publication date: 1980
Peer-reviewed: Yes

Publication information
Journal: Polyhedron
Volume: 16
ISSN (Print): 0277-5387
Original language: English
Source: orbit
Source-ID: 281065

Characterization of Tantalum Pentachloride Containing Melts by Raman Spectroscopy

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Contributors: Huglen, R., Poulsen, F. W., Mamantov, G., Begun, G. M.
Pages: 2551-2555
Publication date: 1979
Peer-reviewed: Yes

Publication information
Journal: Inorganic Chemistry
Volume: 18
Issue number: 9
ISSN (Print): 0020-1669
Original language: English
DOIs:
SCL3 + ALCL4- - IMPROVED SYNTHESIS AND CHARACTERIZATION

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy
Pages: 260-261
Publication date: 1979
Peer-reviewed: Yes

Publication information
Journal: Journal of Inorganic & Nuclear Chemistry
Volume: 41
Issue number: 2
ISSN (Print): 0022-1902
Original language: English
DOI: 10.1016/0022-1902(79)80531-X

Lower Oxidation States of Sulfur. 1. Spectrophotometric Study of the Sulfur-Chlorine System in Molten NaCl-AlCl3 (37-63 mol %) at 150°C

General information
Publication status: Published
Organisations: Department of Chemistry, Energy and Materials, Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Fehrmann, R., Bjerrum, N., Poulsen, F. W.
Pages: 1195-1200
Publication date: 1978
Peer-reviewed: Yes

Publication information
Journal: Inorganic Chemistry
Volume: 17
ISSN (Print): 0020-1669
Original language: English
Source: orbit
Source-ID: 249558

Electrochemistry of Tellurium(IV) in KCl-AlCl3 Melts

General information
Publication status: Published
Organisations: Microstructures and Interfaces, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Energy and Materials, Department of Chemistry
Contributors: Poulsen, F. W., Bjerrum, N.
Pages: 327-336
Publication date: 1977
Peer-reviewed: Yes

Publication information
Journal: Electroanalytical Chemistry: A Series of Advances
Volume: 79
ISSN (Print): 0070-9778
Original language: English
Low temperature vibrational spectroscopy. I. Hexachlorotellurates

Far infrared and Raman spectra of six hexachlorotellurate (IV) salts have been obtained at ~100 K for the first time. In the rubidium, cesium, ammonium, and tetramethylammonium salts the Raman active T2g cation lattice translatory mode was found. In the monoclinic K2[TeCl6] a number of low frequency lattice modes were observed and interpreted in terms of a phase transition near 165 K, similar to transitions in other K2[MX6] salts. The cubic tetramethylammonium hexachlorotellurate salt undergoes a phase transition of supposed first order at a temperature near 110 K, corresponding to transitions known in analogous uranium and tin compounds. Possible reasons for the transitions are discussed. In the low temperature phases the nu4 and nu6 bendings of [TeCl6]2− have been identified with bands near ~130 and ~110 cm−1. No evidence seemed to favor any stereochemical distortion due to the lone pair of electrons present in hexachlorotellurates. The Journal of Chemical Physics is copyrighted by The American Institute of Physics.

Electrical Conductivity of the Molten Bismuth Chloride-Aluminum Chloride, Tellurium Chloride - Aluminum Chloride, and Potassium Chloride - Tellurium Chloride Systems

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Bibliographical note