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In Operando Raman spectroscopy for investigation of solid oxide electrolysis cells

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Raman spectroscopy is an optical, vibrational spectroscopy well suited for in operando investigations, as the technique can be applied at the temperatures and gas pressures used during operation of solid oxide electrolysis cells.

For this reason DTU Energy has invested in a Raman lab dedicated to in operando investigation of solid oxide electrolysis cells – and other electrochemical systems.

In operando monitoring of carbon depositions in a Ni-YSZ cell

The carbon deposition in 50% CO/50% CO₂ at 750 °C was followed on a symmetric Ni-YSZ cell mounted vertically in the test-house to allow for monitoring of the electrochemically active region.

Reversible Decomposition of Secondary Phases in BaO Infiltrated LSM Electrodes—Polarization Effects

Compositional changes in BaO-modified lanthanum strontium manganite (LSM) electrodes where observed during electrical polarization. The applied cathodic potential resulted in a reversible decomposition of a secondary Ba₃Mn₂O₈ phase.

Figure 1. The Raman lab facility at DTU Energy

Available in the Raman lab:
- Renishaw inVia Raman spectrometer
- 3 lasers: 785 nm (NIR), 532 nm (VIS), 325 nm (NUV)
- A wide range of gasses: O₂, Ar, N₂, CO, CO₂, H₂, 9% H₂ in N₂, 1% NO in Ar, 200 ppm H₂S in H₂
- Different testhouses/teststations...

Raman shift [cm⁻¹] Assignment
- 306 Ba₃Mn₂O₈
- 610 MnO₄
- 644 Mn₃O₄
- 773 Ba₃Mn₂O₈
- 1051 MnO/BaCO₃

Figure 2. The mounting of the Ni-YSZ symmetric cell in the Linkam stage

Figure 3. Optical microscopy image of the cell cross-section

Figure 4. Raman spectrum recorded at 750 °C in humidified hydrogen

Figure 5. Raman spectrum recorded at 750 °C in 50% CO/50% CO₂ mixture

Figure 6. EIS recorded at 750 °C in humidified hydrogen and 50% CO/50% CO₂ mixture

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