Determination of the Resistance of Cone-Shaped Solid Electrodes - DTU Orbit
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Determination of the Resistance of Cone-Shaped Solid Electrodes

A cone-shaped electrode pressed into an electrolyte can with advantage be utilized to characterize the electro-catalytic properties of the electrode, because it is less dependent on the electrode microstructure than e.g. thin porous composite electrodes, and reactions with the electrolyte occurring during processing can be avoided. Newman's formula for current constriction in the electrolyte is then used to deduce the active contact area based on the ohmic resistance of the cell, and from this the surface specific electro-catalytic activity. However, for electrode materials with low electrical conductivity (like Ce$_{1-x}$Pr$_x$O$_{2-δ}$), the resistance of the cell is significantly influenced by the ohmic resistance of the cone electrode, wherefore it must be included. In this work the ohmic resistance of a cone is modelled analytically based on simplified geometries. The two analytical models only differ by a model specific pre-factor, which is consequently determined by a finite element model. The model was applied to measurements on cones of Ce$_{1-x}$Pr$_x$O$_{2-δ}$ characterized on an YSZ electrolyte. Conclusively, the finite element model was used to obtain a formula for the resistance for different cone angles with a small contact area. This reproduces Newman's formula for a cone angle equal to 90°, i.e. a semi-infinite body.

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