DissolutionKinetics of Neodymium and Praseodymium Oxides in a 50-50 mol% NdF_3-LiF Melt.

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Abstract

Understanding the dynamics behind the dissolution of rare earth metal oxides in fluorideelectrolytesis important for the efficient and environmental performance of the electrolytic reductionof these oxides. Furthermore, on-line monitoring of the oxide concentration in the fluoride melt will provide anopportunity for optimisation of the oxide feeding systems, thereby contributing to production efficiency.In the present investigations, batches of the rare earth metal oxide, Nd_2O_3 or Nd_2O_3-Pr_6O_{11} (77.5-22.5 wt%),were added to a fluoride meltcomposed of 50 mol% each of NdF_3 and LiFat 1040 °C. The batches of oxide were added every hour for a couple of hours and samples of the melt were taken every half hour and prior to the batch additions for analysis of oxygen content using the inert gas fusiontechnique (TC-436 DR LECO Corp. USA) also called the LECO analysis.For all the dissolution kinetics investigations,a graphite probe was inserted into the melt during the measurements.Fast voltage sweeps (100 V/s) were applied to this graphite probe and the current responses were measured during the oxide dissolution. In the first stage of the voltage sweep, current increases linearly with increasing voltage. As the oxide concentration in the diffusion layer towards the electrode depletes during current ramping, a passive layer is,at a certain point,formed on the probe, resulting in a rapid decrease ofthe current density. This is alsoknown as the critical current density (CCD). The voltage at this point is observed to be proportional to the concentration of the dissolved oxide.When the maximum solubility is reached, the CCD stabilises and the signal can thus be used as a measure of the oxide concentration in the melt.The melt samples taken during the measurements and analysed for oxygen content using the LECO analysisshowed a very good correlation between the approximations based on the voltage at the critical current density and the concentration of dissolved oxides. Figure 1 displays the experimental setup and data from the CCD measurements.

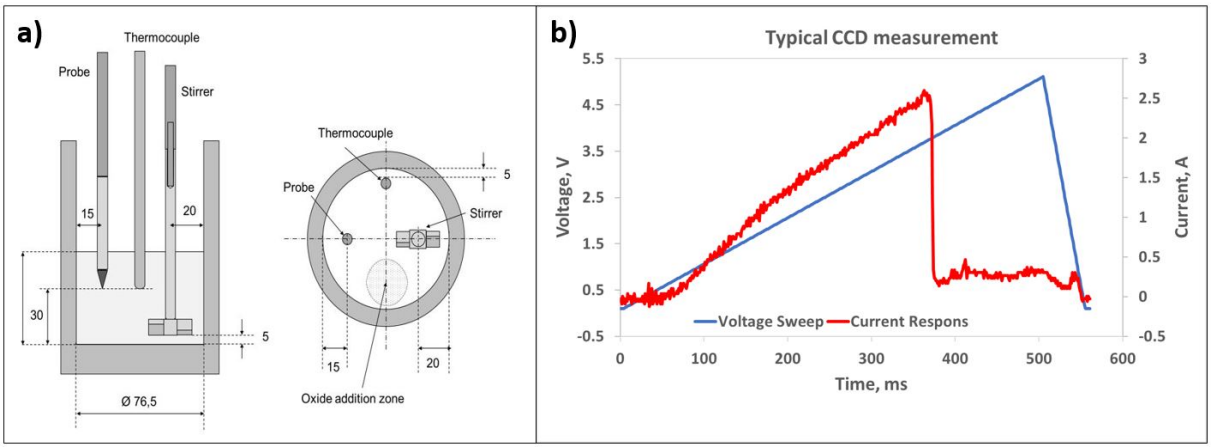

Figure 1. a) Experimental setup for the dissolution and CCD measurements. b)A graph showing typical CCD measurement data.

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