36－59 Quantitative assessment of solid oxide electrochemical doping

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Quantitative analysis of metal cation doping by solid oxide electrochemical doping (SOED) has been performed under galvanostatic doping conditions. A M-β"-Al_2O_3 (M= Ag, Na) microelectrode (contact radius: about 10 μm) was used as cation source in order to attain a homogeneous solid-solid contact between the β"-Al_2O_3 and doping target. In Ag-doping into alkali borate glass, the measured dopant amount closely matched the theoretical value. High Faraday efficiencies of above 90% were obtained. This suggests that the dopant amount can be precisely controlled on a μmol scale by the electric charge during electrolysis. On the other hand, current efficiencies of Na-doping into $Bi_2Sr_2CaCu_2O_y$ (BSCCO) ceramics depended on the applied constant current. Efficiencies of above 80 % were achieved at a constant current of 10 μA (1.6 Acm^{-2}). The relatively low efficiencies were explained by the saturation of BSCCO grain boundaries with Na. By contrast, excess Na was detected on the anodic surface of ceramics at a constant current of 100 μA (16 Acm^{-2}). In the present study, we demonstrate that SOED enables μmol-scale control over dopant amount.

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