"Controlling the sintering of ceria by shape-controlled synthesis of nanoparticles"

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The influence of surface energy of Gd-doped CeO_2 nanometric crystals with different morphologies on mass diffusion mechanisms is studied. Depending on the starting morphology (nanocubes, nanorods, and random nanoparticles) extremely different microstructures, ranging from rapidly densified to thermodynamically stable porous structures. We investigate Gd-doped ceria (10% molar, GDC) both for its relevance in several chemical, environmental and energy technologies, and because the extensive knowledge on diffusion effects ruling this compound. We synthesized GDC as nanocubes (NC) and nanorods (NR) by a hydrothermal method whereas randomly oriented nanoparticles (RD) were obtained by co-precipitation. All samples were measured as single phase GDC powders with narrow nanoparticle size distributions. The high surface area NR exhibit lower green density as compared to NC. Dilatometric analyses revealed that NR have a pronounced linear retraction starting at low temperatures (~200°C) with maximum sintering activity at ~1100°C. High surface energy in NRs leads to a rapid rod to sphere transformation as well as to a rapid densification despite relatively low green density. On the other hand, the solid state diffusion in NCs is significantly inhibited, as confirmed by the highly porous microstructure of sintered samples. The results indicated the possibility of controlling microstructure of GDC by defining the shape of nanoparticles for different application in which dense or stable pores are required.

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