The Thermal Transformation from Lanthanum Hydroxide to Lanthanum Oxide

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Lanthanum hydroxide and lanthanum oxide are of great research interest because of their prospect as catalytic material and application in high-potential oxide ceramics [1]. The thermal transformation of $La(OH)_3$ was studied by high temperature XRD and thermal analysis (DTA/TG, DSC). A description of the experimental results is given by a two step reaction. Lanthanum hydroxide oxide is formed in a first step at ~330°C. It`s structure was characterized by X-ray powder diffraction and subsequent Rietveld refinement. LaOOH crystallizes in the monoclinic space group P21/m (no. 11) with the lattice parameters a = 444.76(9) pm, b = 397.10(7) pm, c = 661.9(1) pm, and β = 111.93(1)° [2]. In a second step lanthanum oxide is formed at ~500°C. The reaction enthalpies of the dehydration process were calculated by DSC to ~82 kJ mol^{-1} (transformation: $La(OH)_3$ to LaOOH) and to ~48 kJ mol-1 (transformation: LaOOH to La_2O_3) [3]. Kinetic analysis using multivariate non-linear regression gives insights into the mechanism of the dehydration reaction. A multi-step model provides an excellent description of the experimental TG results. The activation energies were calculated to EA = 140.4 ± 0.5 kJ mol^{-1} (first reaction step) and 163.9 ± 1,3 kJ mol^{-1} (second reaction step). The corrosponding reaction orders indicate a complex mechanism for both reaction steps.

References

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