Cobalt Incorporation in Mullite

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Mullite (nominally $3Al_2O_3 \cdot 2SiO_2$) is technologically important material for advanced ceramics applications. Depending on the synthesis procedure, mullite is able to incorporate considerable amounts of transition metal cations [1]. While Cr^{3+}, Fe^{3+} and V^{3+} have the strongest tendency of incorporation in mulllite, only low or very low amounts of Fe^{2+}, Co^{2+}, Mn^{2+} and Zr^{4+} ions can enter the mullite structure. A major goal of this work is to determine upper limit of Co^{2+} incorporation in mullite. The samples of pure mullite and of Cr-doped mullite were derived from diphasic precursors and sintered at 1600 ºC for two hours. Four samples were prepared containing 0, 1, 2 and 3 at% Co. They were examined by XRD at room temperature. Samples contained mullite phase and small amounts of α-Al_2O_3 and $CoAl_2O_4$. Unit-cell parameters of the mullite phase were refined by the whole-powder-pattern fitting method [2]. They increased just slightly with increase of cobalt content in the samples. Quantitative phase analysis showed that the samples with 1, 2, and 3 at% Co contained 0.8, 2.5 and 5.1 wt% $CoAl_2O_4$, respectively. These means that ~0.6 at% Co was incorporated in mullite. Same value of upper limit of Co^{2+} incorporation in mullite was obtained on the basis of intensity ratio $I_{(311,\ CoAl2O4)}$ / $I_{(111,\ mullite\ phase)}$, which was linearly dependent on the Co content in the examined samples.

[1] Schneider H., *Ceramics Transactions*, 1990, **6**,135. [2] Toraya H., *J. Appl. Cryst*., 1986, **19**, 440.

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