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Preparation and Doping of $CaLaZrTaO_7$ Pyrochlore

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Received July 31, 1975

Belyaev and co-workers[1] recently have described new, complex compounds with pyrochlore structure. Among these materials was $CaLaZrTaO_7$ which has been further investigated in these Laboratories.

The synthesis of $CaLaZrTaO_7$ consisted of two parts, the first being similar to that described by Belyaev. Lanthanum acetate was reacted with tantalum pentoxide at 1250 °C in air, for ten hours, to yield $LaTaO_4$, as established by X-ray analysis. While Belyaev used calcium zirconate prepared from the oxides, we found multi-phase materials to result. Instead, we prepared a calcium carbonate suspension in water, to which was added a solution of zirconium disulfate. This was then reacted with ammonia, digested (hot) for one hour, filtered and dried. This material was fired at 1300 °C in air, for two hours, ground, and refired for two additional hours, to yield $CaZrO_3$, as established by X-ray analysis.

Equimolar proportions of $LaTaO_4$ and $CaZrO_3$ were mixed well, and pressed into pellets, either hot-pressing or cold-pressing techniques being used. For hot-pressing, the materials were heated in vacuum, at 10^4 psi, at a temperature of 1400°–1450 °C, for four hours. The pressed pellets were then re-fired at 1400 °C in air for four hours, to restore the oxygen stoichiometry.

Materials formed by the above method were examined by both powder (film) X-rays and by diffractometry. Materials formed by hot-pressing were pyrochlore with a lattice constant of about 10.625 Å. A weak second phase, of the order of 5%, was sometimes present, and was probably ZrO_2. Belyaev[1] has reported a lattice constant of 10.567 Å for this pyrochlore.

It is of interest that the material formed by cold-pressing contained *two* pyrochlore phases, in addition to ZrO_2. The major pyrochlore phase was the same as the one reported in the hot-pressing case, with a lattice constant of 10.74 Å, and was possibly $LaTaO_4$.

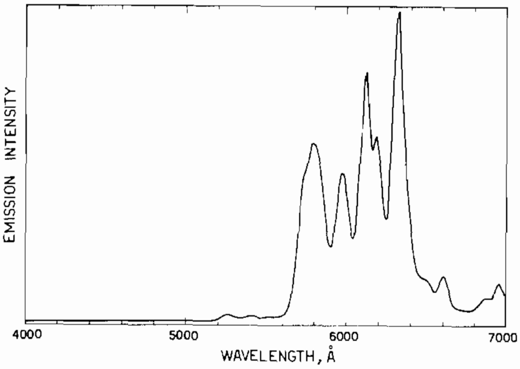

Fig. 1. Spectral distribution of cathodoluminiscence emission from $CaLa_{0.98}Eu_{0.02}ZrTaO_7$.

A luminescent pyrochlore was obtained by doping with europium. Thus, $La_{0.98}Eu_{0.02}TaO_4$ was synthesized, and from this and $CaZrO_2$, $CaLa_{0.98}Eu_{0.02}ZrTaO_7$ was prepared, as described above. Pellets were pressed, using hot pressing, and the resultant materials were examined under cathode-ray excitation. Figure 1 shows the emission spectra obtained for such a material. Activation by other rare-earth ions and by ions of other transition elements also appears feasible.

Acknowledgments

The author is indebted to R. J. Paff for X-ray determinations, to H. I. Moss for pellet-pressing, to J. E. McGowan for synthesis aid, and to J. Gerber for luminescence measurements.

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