Ionic Diffusion-controlled Low Temperature Solid State Reaction Synthesis of Phosphor Materials

K. Toda[1], T. Hasegawa[1], T. Kaneko[1], A. Toda[1], S.W. Kim[1], K. Uematsu[2], T. Ishigaki[1], M. Sato[2], J. Koide[3], M. Toda[3], Y. Kudo[3]

[1]Graduate School of Science and Technology, Niigata University, 8050 Ikarashi 2-nocho, Niigata 950-2181, Japan

Tel.:81-25-262-6771, E-mail: ktoda@eng.niigata-u.ac.jp

[2]Dept. of Chemistry and Chemical Engineering, Niigata University, 8050 Ikarashi 2-nocho, Niigata 950-2181, Japan

[3]N-Luminescence Corporation, 8867-3 Ikarashi 2-nocho, Niigata 950-2101, Japan

Ionic-diffusion in ionic crystal is very slow at room temperature. Therefore, the solid-state reaction method requires a high temperature to synthesize the ceramic materials, including phosphors, with a single-phase form. The synthesis at a high temperature leads to increase in the processing cost and irregular particle morphology of the obtained powders.[1] In contrast, we have recently proposed the novel synthesis methods, such as water assisted room temperature solid state reaction (WASSR) method and solid hydratethermal reaction (SHR) method, to synthesize the ceramic materials in a single phase form at low temperature.[2-5] These methods are very simple and can be synthesized the ceramic materials just by mixing of raw materials added a small amount of water in the case of WASSR method and by storing the mixture of raw materials added a samll amount of water in a reactor at low temperature below 373 K in the case of SHR method. In both methods, water addition is significantly important to proceed the reaction between the raw materials and water act as reaction accelerator. The water phase formed on the surfaces of the raw material powder generated the unstable intermediate phase at the contact points between raw material particles. The unstable phase play a role as a reaction point and promoted the reaction between raw materials. Furthermore, the water phase formed on the surfaces of the raw material powder effectively suppressed the loss of reaction heat produced at the contact points and the stored reaction heat contribute to promote the reaction. The product materials are strongly stirred follow surface of particle due to thermal flow in water phase and it is also causative of the rapid reaction between raw materials at low temperatire due to the formation of new reaction surfaces.

Consequently, we can be successfully synthesized numerous ceramic materials, such as YVO_4, $SrMoO_4$, $BaTiO_3$, and others. Man phosphor materials, YVO_4:Eu^{2+}, $LaPO_4$:Ce^{3+},Tb^{3+}, and $NaEuMo_2O_8$, also successfully synthesized at low temperature below 373 K by the novel synthesis methods proposed. In this study, we present the characteristic and availability of our proposed novel solid phase low temperature synthesis techniques on an industrial application for ceramic materials synthesis processing.

References

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