

## Cation ordering and phase structural transition of Eu<sup>3+</sup>-doped BMN ceramics

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Ba-based Ba(B'<sub>1/3</sub>B''<sub>2/3</sub>)O<sub>3</sub>-type complex perovskites ceramics have got widespread attention owing to their excellent dielectric properties in microwave communication systems. As is known, the sequencing of B-site and octahedral distortion play an important role in dielectric properties like Ba(Mg<sub>1/3</sub>Nb<sub>2/3</sub>)O<sub>3</sub>(BMN) and Ba(Mg<sub>1/3</sub>Ta<sub>2/3</sub>)O<sub>3</sub>(BMT) based ceramics [1]. Hence, it is meaningful to explore how structure changes in these materials. The photoluminescence properties of rare-earth (RE) ions is strongly dependent on the crystal symmetry of the sites occupied [2], which promises an alternative way to explore the structure characters in dielectric materials, such as cation ordering and octahedral distortion, by introducing a small of quantity of rare-earth (RE) ions and characterizing their luminescence properties. This work aims to investigate how the structure changes in Ba(Mg<sub>1/3</sub>Nb<sub>2/3</sub>)O<sub>3</sub>(BMN) with different sintering temperature by utilizing Eu<sup>3+</sup> ions as a probe.

The Ba<sub>0.97</sub>(Mg<sub>1/3</sub>Nb<sub>2/3</sub>)O<sub>3</sub>:3%Eu<sup>3+</sup>(BMN:3%Eu<sup>3+</sup>) ceramic powders were prepared by conventional solid-state reactions with different temperature. In this work, the phase structure, cation ordering and photoluminescence properties of Ba<sub>0.97</sub>(Mg<sub>1/3</sub>Nb<sub>2/3</sub>)O<sub>3</sub>:3%Eu<sup>3+</sup>(BMN:3%Eu<sup>3+</sup>) ceramics were characterized. The XRD Rietveld refinement, Raman spectra and photoluminescence of Eu<sup>3+</sup> ions demonstrated that the prepared ceramic phosphors undergo a cubic-hexagonal phase transformation with the sintering temperature increasing(1350 ~ 1500 °C), leading to cation ordering change of B sites and NbO<sub>6</sub> octahedral distortion in BMN. Photoluminescence properties of Eu<sup>3+</sup> ions were studied based on Judd-Ofelt and crystal symmetry theories. There are two major emission peak at 598nm and 615nm due to transition magnetic dipole transition of <sup>5</sup>D<sub>0</sub>-<sup>7</sup>F<sub>1</sub> and electric dipole transition of <sup>5</sup>D<sub>0</sub>-<sup>7</sup>F<sub>2</sub>, respectively. By calculating the asymmetry ratio (*R*) that is intensity ratio of transitions <sup>5</sup>D<sub>0</sub>-<sup>7</sup>F<sub>2</sub> to <sup>5</sup>D<sub>0</sub>-<sup>7</sup>F<sub>1</sub>,  $R=I_2(^5D_0-^7F_2)/I_1(^5D_0-^7F_1)$ , the symmetry of the crystal field environment around Eu<sup>3+</sup> ion can be detected. These results illustrated that relationship between luminescence performance and structure, providing theoretical support for a small quantity of Eu<sup>3+</sup> ions can be served as a structural probe for these dielectric material.

1. D.K. Patel, B. Vishwanadh, V. Sudarsan, et al., *J. Am. Ceram. Soc.* **96** (2013).
2. X.M. Chen, T.L. Sun, et al., *AIP Advances.* **5**, 017106 (2015).