

Photoluminescence activity of BaTiO₃ nanocubes via facile hydrothermal synthesis

ABSTRACT

Free from scaling effect is highly desirable but yet challenging in lead-free BaTiO₃ (denoted as BTO). In this work, we revisit the synthesis BTO nanocubes via hydrothermal route and provide an insight on the photoluminescence behavior of BTO nanocubes, whilst others focus on the reproducibility of BTO nanocubes. The crystallinity of the BTOs was enhanced when the as-synthesized powders underwent calcination at elevated temperatures (> 500 °C). A combination of X-ray diffraction (XRD) patterns and transmission electron microscopy (TEM) images affirms that the BTO nanostructures evolved from cubic to tetragonal and changing from pseudo-ellipsoid to nanocube with {100} sharp facets. The tunable optical band gaps (3.18–2.74 eV), Urbach tails in UV–Vis absorption spectra and the enhanced intensity of photoluminescence at violet wavelength (433.7 nm) indicate the presence of localized state. In order to sort out the origin of the localized state, either stems from structural disorder or surface state, time-resolved photoluminescence was carried out. The long decay of the time-resolved photoluminescence (>100 ns) proves the dominant involvement of self-trapped states. This in turn narrows the band gap, thus facilitates photoluminescence excitation.