Luminescence properties and kinetic parameters of nanocrystalline BaxSr1-xSO4:Dya%,Tbb% powder under gamma excitation

ABSTRACT

In this study, nanocrystalline barium strontium sulfate complex BaxSr1-x(=0.12,0.50,0.88,0.94)SO4:Dya(=0.1,0.2,0.5,1.5%),Tbb(=0.2,0.4,1,1.5%) powders were prepared via a chemical co-precipitation method at room temperature. The nanocrystalline powders were characterized using X-ray diffraction, scanning electron microscopy, energy dispersive X-ray spectroscopy, transmission electron microscopy, UV–visible spectrometry, thermoluminescence (TL), and photoluminescence. Under gamma ray irradiation, the maximum intensity of the TL glow curves for BaxSr1-xSO4:Dy0.1%,Tb0.2% was obtained with x = 0.88. The nanocrystalline Ba0·88Sr0·12SO4:Dy1.5%,Tb1% powder was selected because of its high intensity glow curve with a good shape. The TL response of Ba0·88Sr0·12SO4:Dy1.5%,Tb1% after irradiation with different gamma doses exhibited linear behavior from 0.01 to 7 kGy and 1–15 kGy. A glow curve deconvolution method and MATLAB software were used to calculate the TL kinetic parameters and the results obtained were investigated in detail. Moreover, the emission spectra obtained for the Ba0·88Sr0·12SO4:Dy1.5%,Tb1% and Ba0·88Sr0·12SO4:Dy0.5%,Tb1.5% nanocrystalline powders at an excitation wavelength of 350 nm showed that the efficiency of the energy transfer from Dy3+ to Tb3+ ions was increased by increasing the Tb3+ ion concentration in Ba0·88Sr0·12SO4.

Keyword: Barium strontium sulfate; Gamma irradiation; Luminescence