Bulletin of Materials Science

Time-resolved fluorescence decay and Gaussian analysis of P3HT-derived Ho3+- and Tm3+-doped ZnO nanostructures

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https://link.springer.com/article/10.1007/s12034-019-2020-0

Abstract

The fluorescence vibrational features of as-synthesized P3HT–ZnO:Ho3+ and P3HT–ZnO:Tm3+ thin films were investigated using Gaussian analysis. Relative to P3HT–ZnO:Tm3+ film, detailed Gaussian analysis of the fluorescence spectra revealed weaker intensity exhibited in P3HT–ZnO:Ho3+ film due to better charge transfer. Moreover, we comparatively present the Huang–Rhys factor and relaxation energy of the samples, which are calculated using relations derived from the Franck–Condon theory. Furthermore, P3HT–ZnO:Ho3+ film exhibits lower relaxation energy as compared with P3HT–ZnO:Tm3+ film, which implies better conjugation length. Finally, the singlet exciton lifetime of P3HT–ZnO:Ho3+ sample was found to be shorter as compared with P3HT–ZnO:Tm3+, while the calculated exciton diffusion length was 6.4 and 10.3 nm, respectively.