Luminescent properties of polymer nanocomposites doped with europium and terbium M-O complexes

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The recent years observed an intensive development of optoelectronic devices and systems using a compact, high efficient short-wavelength radiation sources, both coherent and incoherent. Demand for light within the visible spectral range (red, green and blue as well as white, obtainable as a combination of these three colors) results from a number of application areas, covering in particular imaging, information recording and processing techniques, medical diagnostics, optical communications and many others. Impressively wide range of applications stimulate research on the new active materials offering the advantages of efficient luminescence, excellent thermo-mechanical properties, low power consumption and low-cost of manufacturing. One of the attractive candidates seem to be the polymer-based nanocomposites, combining good optical and thermo-mechanical properties of polymer matrices and excellent luminescence properties of rare-earth ions doped crystalline materials.

This work reports the results of investigations on luminescence properties of this new class of optically active materials - composites based on polymer matrices doped with metal-organic complexes. The set of europium and terbium complexes with different ligand surroundings has been designed, manufactured and carefully characterized with respect of both structural and luminescent properties. The optimal ligand structures for each ion have been determined for obtaining best luminescent properties. In particular, it has been shown, that precise selection of structural surroundings of RE^{3+} ion is responsible not only for effective isolation of active ions from the environment (which results in longer fluorescence lifetimes and higher emission intensities), but also for localization of excitation band related with ligand-lanthanide energy transfer processes (which in most cases is much more efficient than direct excitation via energy levels of RE^{3+}).

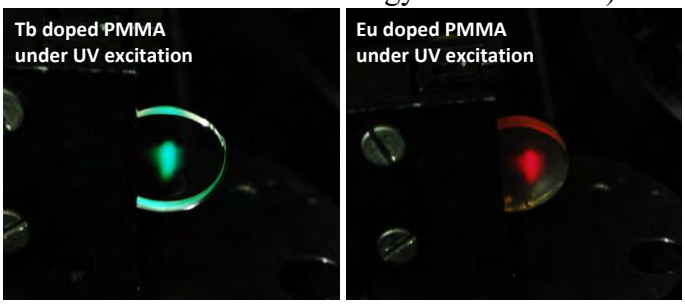

Fig. 1. Photograph of PMMA-based bulk composite samples doped with terbium (left) and europium (right) complexes under incoherent UV excitation.

The metal-organic complexes with best emission properties has been finally embedded into the PMMA matrix and manufactured in a form of bulk composite materials (Fig. 1). The following spectroscopic characterization allowed analysis of the main excitation and de-excitation mechanisms as well as discussion of the polymer matrix influence on spectroscopic properties of original complexes.

Keywords: polymer fiber, active polymer, europium, terbium, complex

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