

THIN FILMS OF LUMINESCENT TERBIUM AROMATIC CARBOXYLATES FOR OLED APPLICATION

V. Utochnikova*, A. Kalyakina, O. Kotova, N. Kuzmina
Lomonosov Moscow State University

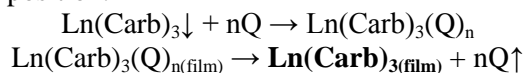
Rare earth elements (REE) coordination compounds possess such unique luminescent properties as quasi-monochromatic luminescence, which makes them perspective materials for a wide range of applications. One of the main goals in use of such materials today is to obtain compounds with the high UV stability [1]. Among such materials substituted REE benzoate take a noticeable place since they also exhibit high photoluminescence quantum yield, which reaches 100% in case of Tb(bz)₃ [2]. However the problem of their low solubility and volatility arise since they have a polymeric structure which makes coating their thin films almost impossible, which limits considerably their use in planar devices. Thus, it is necessary to create new methods of deposition of REE aromatic carboxylates thin films of high quality.

This work is devoted to the development of two new methods of aromatic terbium carboxylates Tb(Carb)₃ thin films deposition, where HCarb is benzoic acid (Hbz) and *o*-phenoxybenzoic acid (Hpobz). We offer two different methods of thin films deposition, both of which are based on the chemical reactions leading to the formation of Tb(Carb)₃ thin films. The first method of reactive chemical vapor deposition (RCVD) is based on the exchange reaction between volatile precursors: REE β-diketonate and aromatic carbonic acid.



Initially basics of this reaction were established on example of interaction between Ln(dpm)₃ (Ln = Tb, Lu) and *o*-substituted benzoic acids: Hbz (benzoic acid), HSal (salicylic acid), Habz (aminobenzoic acid), HPA (phenylantranilic acid), and Hpobz (*o*-phenoxybenzoic acid), which differs by chemical stability and volatility [3]. Afterwards experimental conditions for smooth, even and transparent thin films of Tb(bz)₃ and Tb(pobz)₃ with the thickness of 50-100 nm were found, which was necessary for organic light-emitting diode (OLED) fabrication. OLED based on Tb(bz)₃ with the structure glass/ITO/PEDOT:PSS/TPD/Tb(bz)₃/Ca:Al demonstrated electroluminescence caused by current flow through the Tb(bz)₃ film.

The second approach is based on the spin-coating of the thin film of soluble mixed-ligand complex (MLC) Ln(Carb)₃(Q)_n (Q – triphenylphosphine oxide, TPPO; acetylacetonate imine, Hacim) with its following thermal decomposition:



Neutral ligand Q has to: 1) form MLC with Tb(Carb)₃, 2) remove easily from MLC at heating, and 3) be highly volatile. Because of the low film thickness (100-200 nm) it is difficult to examine their composition via convenient methods, so we used combination of spectroscopic methods: 1) IR and Raman spectroscopy, which demonstrates different C–H vibrations and also P–Ph vibration in case of TPPO; 2) excited state lifetime (Tb(III); ⁵D₄); 3) excitation spectra character. It was shown that TPPO removal at high temperature leads to the partial complex decomposition in the film, while complexes with Hacim can be easily obtained in thin film state and transferred to the Tb(Carb)₃. At the same time thermal treatment leads to the surface smoothen and film roughness reduces from 9 nm to 4 nm.

[1] S.V. Eliseeva, J.-C.G. Bünzli, Chem. Soc. Rev., 2010, 39, 189–227

[2] M. Bredol, U. Kynast and C. Ronda, Adv. Mater., 1991, 3, 361

[3] V.V. Utochnikova, O.V. Kotova, E. M. Schukina, S.V. Eliseeva, N.P. Kuz'mina, Russ. Inorg. Chem., 2008, 1-7, 53 №12