Sol-Gel Derived Lanthanide-Substituted Layered Double Hydroxides Mg$_3$/Al$_{1-x}$Ln$_x$

A. Kareiva$^1$, A. Smalenskaite$^1$, S. Şen$^2$, A. N. Salak$^3$, M.G.S. Ferreira$^3$, A. Beganskiene$^1$

$^1$Department of Inorganic Chemistry, Institute of Chemistry, Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania

$^2$Department of Chemistry, Faculty of Arts and Sciences, Dumlupınar University, 43820 Kütahya, Turkey

$^3$Department of Materials and Ceramic Engineering/CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

Recently, considerable attention has been focused on incorporating rare earth ions into LDHs hosts to develop new functional materials, which resemble designed optical properties [1]. LDHs doped with Tb$^{3+}$ ions in the brucite-like layers were prepared by a simple one-step co-precipitation method [2, 3]. Nanosized LDHs doped with Eu$^{3+}$, Yb$^{3+}$, Tb$^{3+}$ and Nd$^{3+}$ were prepared through the microemulsion method [4]. The Eu$^{3+}$ and Nd$^{3+}$ were incorporated also into hydrocalumite and mayenite [5]. The Zn/Al/Eu and Zn/Al/Dy LDHs were also reported as perspective and efficient luminescent materials [6-8]. Cerium-doped hydrotalcite-like precursors were also recently synthesized by co-precipitation method [9].

The main aim of this study was to investigate Nd$^{3+}$, Sm$^{3+}$ and Eu$^{3+}$ substitution effects in the Mg$_3$/Al$_{1-x}$Ln$_x$ systems (the Ln$^{3+}$ concentration in the crystal lattice was changed from 0.05 to 10 mol%) fabricated for the first time to the best our knowledge by sol-gel synthesis route.

The Mg$_3$/Al$_{1-x}$Ln$_x$ LDH samples were synthesised by sol-gel method from the solution of metal nitrates, dissolved in 50 ml of distilled water. Secondly, 0.2 M citric acid was added and obtained solution was stirred for 1 h at 80 °C. Next, 2 ml of ethylene glycol have been added to the resulted mixture with continues stirring at 150 °C until the complete evaporation of solvent. The obtained gel was dried at 105 °C for 24 h. The Mg$_3$/Al$_{1-x}$Ln$_x$ LDH specimens were obtained by reconstruction of MMO powders in water at 50 °C for 6 h under stirring. The samples obtained were characterized by X-ray diffraction (XRD) analysis, Fourier Transform Infrared spectroscopy (FT-IR), thermogravimetric (TG) analysis and scanning electron microscopy (SEM). The luminescent properties of Mg$_3$/Al$_{1-x}$Ln$_x$ LDH samples were also investigated. The results revealed that lanthanide element enters into a hydrotalcite structure containing Mg$^{2+}$ and Al$^{3+}$ cations in the brucite-like layers.

Acknowledgement. The work has been done in frame of the project TUMOCS. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 645660.