Physico-Chemical Nanomaterials Science

Study on morphology, luminescence, and dielectric properties of nanoscale lanthanide phosphonates

J.K. Zaręba[1], A. Ciżman[2], M. Samoć[1], M. Nyk[1]

[1] *Advanced Materials Engineering and Modelling Group, Faculty of Chemistry, Wrocław University of Science and Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland. E-mail: jan.zareba(at)pwr.edu.pl*

[2] *Institute of Physics, Wrocław University of Science and Technology, Wybrzeże Wyspiańskiego 27, 50-370, Wrocław, Poland*

Coordination polymers (CPs) are a class of hybrid materials possessing metal ion-based nodes and polytopic organic linkers. Owing to large number of available metal ions and ligands, a plethora of CPs has been synthesized and characterized, often being attractive as materials for specific purposes. To those one can include "traditional" applications as catalysis[1] and gas sorption and separation[2], but also novel photonic phenomena have been recently targeted such as stimulated emission, triplet-triplet annihilation or two-photon absorption.[3]

When nanoparticles of CPs are considered for any application, the detailed knowledge on morphology and related size-effects is needed. In this contribution we will present our investigations on nanoscale lanthanide (Ce, La, Nd, Eu, Gd, Tb) phosphonates, based on 1,4-diphosphonobenzene. Transmission electron microscopy shows that those materials tend to form irregular flat structures, with diameters ranging from 50 to 100 nm. Dielectric measurements of those nanomaterials between -120 and 300 °C show that dielectric permittivity ε' is between 5 and 6 at 100 kHz, which is close to the range of so-called "low-κ dielectrics"; no significant dielectric relaxation processes have been noted. Study on emission properties of europium analogue shows that the relative intensity of hypersensitive $^5D_0 \rightarrow {}^7F_2$ transition is different for nanomaterial than that of microcrystals, which indicates change of local symmetry of Eu^{3+} ions. Details on those investigations as well inputs from other characterization techniques (PXRD, IR) will be provided.

1. *Corma A., García H., Llabrés I, Xamena F.X.* Engineering metal organic frameworks for heterogeneous catalysis // Chemical Reviews (2010) 110, 8, pp. 4606-4655.
2. *Eddaoudi M., Li H., Yaghi O.M., Reinstein J.* Highly porous and stable metal-organic frameworks: Structure design and sorption properties// Journal of the American Chemical Society (2000) 122, 7, pp. 1391-1397.
3. *Medishetty R., Zaręba J.K., Mayer, D., Samoć, M., Fischer R.A.* Nonlinear Optical Properties, Upconversion and Lasing in Metal-Organic Frameworks // ChemSocRev, (2017) *accepted for publication*