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#### **Hydro/solvo-thermal synthesis of surface modified NaYF<sub>4</sub> co-doped Yb<sup>3+</sup>/Er<sup>3+</sup> up-conversion nanoparticles**

Ivana Z. Dinić,<sup>1</sup> Lidija Mančić,<sup>1</sup> Maria Eugenia Rabanal,<sup>2</sup> Olivera B. Milošević<sup>1</sup>  
<sup>1</sup>*Institute of Technical Sciences of SASA, 11000 Belgrade, Serbia,* <sup>2</sup>*Materials Science and  
Engineering Department and IAAB, Universidad Carlos III de Madrid, 28911 Leganes,  
Spain*

Surface modified up-conversion rare earth fluorides have attracted attention in recent years. Owing to their unique optical properties they can be used for biomedical application such as bio-detection, fluorescence imaging and in drug delivery systems. Different synthesis methods which generate nano- and micro-crystals with controllable compositions have been reported. For improved control of size, shape and morphology of the particles surfactants or structure directing agents are used. In this work PEG or PVP capped NaYF<sub>4</sub> particles were synthesized using hydro/solvo-thermal synthesis at 200 °C (3h). Their structural, morphological and luminescence characteristics have been studied based on X-ray powder diffractometry (XRPD), Fourier transform infrared spectroscopy (FTIR), energy dispersive spectroscopy (EDS), scanning and transmission electron microscopy (SEM/TEM) and photoluminescence measurements. Both polymers proved to be a good structure directing agents enabling generation of the well crystalline polymer coated upconverting particles with efficient emissions in visible spectrum. It was shown that generation of the hexagonal P6<sub>3</sub>/m β-NaYF<sub>4</sub>:Yb<sup>3+</sup>/Er<sup>3+</sup> phase with the most efficient green emission (CIE 0.31, 0.66) is enhanced when PVP is used during synthesis, while formation of the cubic Fm-3m α-NaYF<sub>4</sub>:Yb<sup>3+</sup>/Er<sup>3+</sup> phase that has a yellowish spectral output (CIE 0.41, 0.56) was observed in the particles produced in the presence of PEG. Increase of the luminescence intensity was achieved with additional particles annealing in argon atmosphere at 400 °C (5h).

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#### **Pseudobrookite TiFe<sub>2</sub>O<sub>5</sub> nanostructured thick films**

Zorka Z. Vasiljević,<sup>1</sup> Obrad S. Aleksić,<sup>2</sup> Miloljub D. Luković,<sup>2</sup>  
Maria V. Nikolić,<sup>2</sup> Nikola B. Tasić<sup>2</sup>

<sup>1</sup>*Institute of Technical Sciences of SASA, Knez Mihailova 35, Belgrade, Serbia,* <sup>2</sup>*Institute for  
Multidisciplinary Research, University of Belgrade, Kneza Visaslava 1, 11000 Belgrade,  
Serbia*

TiO<sub>2</sub> (anatase) and Fe<sub>2</sub>O<sub>3</sub> (hematite) nanopowders were mixed in the weight ratio 1:1.5 and 1:2 and homogenized in a planetary ball mill for an hour. After that pastes were prepared of the two powder mixtures, organic vehicle and glass frit. The pastes were screen printed on FTO coated glass substrates and sintered at 800°C/10 minutes. Formation of monoclinic pseudobrookite was confirmed by XRD analysis of the thick film samples. The thick film crystal structure and optical properties were observed by SEM and UV/Vis spectroscopy. Current-voltage analysis was performed on a sandwich structure formed of thick film and two conductive FTO layers (bottom and top).