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# NIR photo-driven upconversion in amino and carboxyl functionalized NaYF4:Yb,Er particles for in vitro cancer cell imaging

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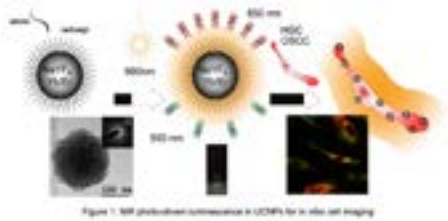
Lanthanide-doped fluoride up-converting nanoparticles (UCNPs) represent the imaging contrast agents which hold great potential for overcoming existing problems associated with traditionally used dyes, proteins and quantum dots. Over the last decade, decomposition of organometallic compounds has been indicated as one of the most convenient method for the synthesis of monodisperse NaYF4:Yb/Er UCNPs. Still, their biological application is restricted due to the fact that such synthesis must be followed by SiO2 encapsulation or ligands exchange to render them biocompatible. Herein, one-step polymer assisted solvothermal route is used for in situ synthesis of amino- or carboxyl- functionalized NaYF4:Yb,Er UCNPs that have hydrophilic surface capable for conjugation of biomolecules. Structural, morphological and optical properties of particles revealed nucleation of the cubic (Fm-3m) or hexagonal (P63/m) phases in spherical and elongated nanoparticles, respectively. UCNPs up-conversion efficiency was determined by measuring the intensity of blue (at 408 nm, due to 2H9/2 →4I11/2 transition), green (at 520 i 540 nm, due to 2H11/2, 4S3/2→4I15/2 transitions) and red (at 655 nm, due to 4F9/2 → 4I15/2 transition) emission after excitation by NIR ( =980 nm) light and calculating (X,Y) CIE chromatic coordinates. UCNPs cytotoxicity and cell labeling capability was tested in vitro toward oral squamous cell carcinoma (OSCC), the most common malignant tumor of the head and neck, which early stages are asymptomatic and very similar to other mucosal diseases. Having in mind that great majority of investigations is focused on cancer cell testing, the potential cytotoxicity of UCNPs was additionally tested against human gingival cells (HGC) isolated from healthy gingival tissue. Low cytotoxicity against HGC and a dose dependent viability of OSCC indicates that these might be promising candidates for targeted therapy of cancer. A facile approach presented in this study may be extended to the synthesis of UCNPs with other biocompatible ligands raising at that way their use in biomedicine.



## Biography

Lidija Mancic has her expertise in soft chemistry synthesis (spray pyrolysis, hydrothermal, exfoliation/intercalation) and characterization of the hybrid nanoparticles. Currently she is engaged in innovative processing and characterization of hierarchically organized optically active particles (up- and down-convertors) with multifunctional properties that could be used for opto-electronic, bio-medicine, security/forensic and environmental remediation. More precisely, she study heterogeneous nucleation at gas/liquid/solid interface in core@shell nanoparticles, multifunctional oxides and advanced inorganic biomarkers (labels for cancer cells). She is the coordinator of research activities defined by the Cultural, Education and Scientific Agreement signed between the Faculdades Catolicas RJ (Brazil) and the ITS SASA and is engaged in several domestic and international projects. She is a member of the Committee for Standardization in Nanotechnology in Serbia, serves as Scientific Committees Member and Program Chair of the Advanced Ceramics and Application Conferences, and is Secretary of the Serbian Chapter of American Ceramic Society. List of her publications is available at https://orcid.org/0000-0002-6620-9582

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