VINGNANAM Research Conference

21st of July 2022

VRC–2022

Faculty of Science
University of Jaffna
Sri Lanka

Jointly Organized by

Faculty of Science
University of Jaffna
Sri Lanka

Western Norway University of Applied Sciences

Microwave-assisted synthesis of lanthanide-based calcium fluoride nanoparticles for luminescent applications

C. R. De Silva

Department of Chemistry and Physics, College of Arts and Sciences, Western Carolina University, Cullowhee, NC, 28723, United States

Correspondence: mhdesilva@wcu.edu

Nanotechnology deals with materials in the nanometer size range and promises future applications in biomedical sciences. Among the metal-based nanomaterials, calcium fluoride has received recent attention in biomedical sciences due to its limited toxicity, biocompatibility, and stability. In addition, lanthanide-based fluoride nanoparticles exhibit impressive luminescent properties, including narrow luminescent bands, longer luminescent lifetimes, large Stokes shifts, and limited photo-bleaching. Recent methods of making calcium fluoride nanoparticles include co-precipitation, hydrothermal, microemulsion, and sol–gel processes. Notwithstanding the current progress, it is essential to develop reproducible synthetic methods for making high quality nanoparticles with improved monodispersity. Herein, we introduce a microwave-assisted synthetic method for making europium-doped calcium fluoride nanoparticles with high reproducibility, colloidal stability, and monodispersity. Powder X-ray diffraction studies confirmed that the nanoparticles have a cubic structure. The europium doping levels ($1 - 35$ %) did not significantly alter the crystal structure of calcium fluoride. Transmission electron microscopy images confirm the production of highly monodispersed nanoparticles with a flower-like structure and a rough surface. The size of the nanoparticles can be varied between 40 – 1000 nm by changing the microwave conditions and the initial reactant concentration. The nanoparticles exhibit europium (III)-based luminescence at 615 nm with a full-width at half maximum of 15 nm upon 340 nm excitation. A luminescent quantum yield of 1.5 % was observed with 15 % europium doping. Optimization of the luminescent efficiency by a surface engineering process is in progress.

Keywords: Calcium fluoride, nanoparticles, lanthanide, nano-synthesis, luminescence.

Acknowledgment: This research work was supported by the Department of Chemistry & Physics at Western Carolina University, USA.