Development of Nano Cerium Doped Yttrium Orthosilicate (YSO:Ce) Particulates For Optogentics Applications

Eric Zhang[1], Ashley Dickey[2], Mary Burdette[3], Kelli Cannon[4], Yura Bandera[5], Hanno Zur Loye[6], Mark Bolding[7], Jeffery Anker[8], Joseph Kolis[9], *Stephen Foulger[10]

[1]PhD Student, Department of Material Science and Engineering, Clemson University, [2]PhD Student, Department of Chemistry, Clemson University, [3] PhD Candidate, Department of Material Science and Engineering, Clemson University, [4]PhD Student, Department of Neuroscience, University of Alabama of Birmingham, [5]Research Associate, Department of Material Science and Engineering, Clemson University, [6]Associate Dean for Research and Graduate Education/ David W. Robinson Palmetto Professor, Department of Chemistry, University of South Carolina, Columbia, [7]Associate Professor, Division of Advanced Medical Imaging Research, University of Alabama of Birmingham, [8]Wallace R . Roy Distinguished Associate Professor, Department of Chemistry, Clemson University, [9]Distinguished Tobey-Beaudrot Professor, Department of Chemistry, Clemson University, [10]Greg-Graniteville Endowed Chair and Professor Department of Material Science and Engineering, Clemson University

*foulger@clemson.edu

Key Words: Optogentics, Nanoparticles, Scintillator, Yttrium Orthosilicate

Abstract: Optogentics is a field of study that couples optics and biology to control living tissues. In principle, a 470 nm blue LED light guided through a fiber optics cable is invasively inserted through the cranial of a genetically modified animal specimen expressing certain light sensitive ion pump channels. Such invasive technique can have negative effects such as localized heating and surgical damages that follow any invasive techniques. A noninvasive technique is proposed here using cerium orthosilicate nano particles as an alternative methodology to study optogentics.

Cerium doped rare earth silicates have attractive attributes for x-ray luminescence applications. These include a high effective atomic number, high photon emission efficiency, and fast decay time. Conventionally the Czochralski method is used to form single crystal scintillators scaling from micron size and larger, however this process lacks the ability to synthesize particles with dimensions under 100nm. Other approaches to fill in the missing size range include precipitation, sol gel, and core-shell synthesis. The latter technique having the ability to form monodisperse particles with controllable size.

In this work, less than 100nm rare earth silicate scintillator particles were synthesized using a core shell methodology. Using the well-known Stöber process, 70nm silica particles were synthesized as the nucleation sites for the rare earth compounds to grow on the periphery of these particles. The phase formation, photo physical properties, and size of these rare earth silicate particles were systematically investigated.