Advanced Functional Nanomaterials School

Yachay Tech University-2020

Luminescent nanostructures in ceramic materials

Naira Maria Balzaretti
Institute of Physics Universidade Federal do Rio Grande do Sul
Porto Alegre, RS – Brazil
naira@if.ufrgs.br

Part 1 (2 h) - quantum dots

Definition
Electronic properties
Luminescence
Synthesis: semiconductors and carbon quantum dots

Abstract: Semiconductor nanoparticles smaller than 10 nm exhibit distinct properties that can be investigated considering the behavior of electrons in potential wells. The interaction of these structures with light promotes interesting luminescence effects associated with the size of the nanoparticle and to the functional groups on its surface. In this part, the definition, electronic properties and luminescence of quantum dots will be presented. Experimental aspects of synthesis and characterization of semiconductor and carbon quantum dots will be discussed.

Part 2 (2 h) - luminescent nanostructures in ceramic materials: effect of high pressure

Carbon quantum dots in silica produced by pyrolysis under high pressure
Fluorescent silica produced by high pressure sintering
Rare earth doped glasses containing metallic nanoparticles (nanoantenna effect)

Abstract: In this part, experimental aspects of the synthesis of carbon quantum dots in silica produced by pyrolysis under high pressure will be presented. The luminescent properties of the quantum dots will be discussed. In addition, the synthesis and luminescent properties of heavy metal glasses (PbO-GeO_2 matrix) doped with rare earth ions (Sm, Nd, Pr) containing metallic nanoparticles will be presented. The effect of densification under high pressure on the luminescence properties will also be discussed. It will be shown that the luminescent properties can be amplified or hindered in the presence of the metallic nanoparticles (plasmon effect) under high pressure.

Part 3 (2 h) - applications of luminescent ceramic materials

Solar cells
Biomedicine

Photonics

Laser

Abstract: some examples of application of quantum dots and luminescent ceramic or glasses will be presented. The idea is to connect the effect of the interaction of light with these structures with practical applications such as in the conversion of light into electrical energy (solar cells); use of light conversion to interact with human tissues; especially for bioimaging (biomedicine); use of light (usually infrared) for telecommunication and other devices (photonics), and for laser applications. Quantum dots and luminescent ceramics can increase the efficiency and effectiveness of these devices.

*Evaluation (suggestion): each group would choose a specific technological application using quantum dots or luminescent ceramic and make a presentation for the class (no more than 10 min), considering the basic fundaments behind the application.