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Nanostructured materials for applications in photonics and food science

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Abstract

In this seminar, some applications of optical spectroscopy in materials and food science will be presented. The first subject consists of quantum cutting luminescence for solar cells application. In the quantum-cut optical phenomenon, two lower-energy photons are obtained by the energy partition of a high-energy photon. As a consequence, this process opens the possibility of its application in solar cells technology in order to enhance the efficiency of the latter via thermal loss prevention without structural change. In the present case we studied the influence of Yb³⁺ ions on near infrared quantum cutting luminescence (~1.0 and 2.0 μm) in Pr³⁺/Yb³⁺ codoped glasses through 443 nm excitation. Then we move for multilayered and nanostructured doped silica fiber for Second Harmonic Generation (SHG). In the former, the doped core consists of alternating germanium layers (or phosphorous). Through poling process, doped layers trap positive charges that migrate due to strong electric potential difference. This breaks the translational invariance of the fiber producing second harmonic light after the input of pulsed infrared laser. The second approach was the adoption of multi-composition core fiber. In this approach metal nanoparticles were incorporated into fiber core. In our case, WO_{3-x} nanoparticles were incorporated along with aluminum via MCVD coupled with solution doping technique. These fiber samples have shown high SHG intensity as obtained by optical spectrum analyzer. The last subject concern two applications in Food Science Technology.

The first method consists of a device to determine protein concentration in milk based on the detection of the integral current generated by a quantum dot infrared photodetector fabricated with III-V semiconductors by researchs of DISSE –National Institute of Science and Technology in Semiconductor Nanodevices. The second example consists of a methodology, time-resolved photoluminescence, to determine the amount of milk fat and therefore the type of milk: skimmed milk, whole milk and semi-skimmed milk.

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