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SPECTROSCOPY OF MOLECULES AND CRYSTALS

Book of Abstracts
of XXVI Galyna Puchkovska International School-Seminar

Dedicated to 90th birthday of Professor Galyna Puchkovska

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Professor Galyna Puchkovska (June 22, 1934- September 29, 2010) is a famous Ukrainian scientists, physicist, Laureate of the State Prize of Ukraine, Honored Worker of Science and Technology of Ukraine, member of European Academy of Arts, Sciences and Humanities.
In 1973, Galyna Puchkovska initiated the all-Ukrainian School-Seminars "Spectroscopy of Molecules and Crystals" which since 1991 became an international one being among the first of such kind scientific meetings in Ukraine. In 2011, after professor Galyna Puchkovska's pass away, the International School- Seminar "Spectroscopy of Molecules and Crystals" was named in her honor. The ISSSMC conferences headed by professor Puchkovska were held for almost 35 years biennially in different cities of Ukraine, even in the most severe times for our country, and are still traditionally organized nowadays as a recognized world-wide meeting of spectroscopists from different research fields.

Hydrogen Peroxide Detection Using Reversible Luminescent CeO_{2-x} and $CeO_{2-x}:Eu^{3+}$ Nanocrystals

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Hydrogen peroxide (HP) is a prevalent industrial chemical used extensively for bleaching, cleaning, and disinfection. In biological systems, HP acts as a crucial signaling molecule and is involved in various enzymatic processes as a substrate or byproduct, such as those involving catalase, superoxide dismutase, and numerous oxidases and peroxidases [1, 2]. Thus, precise HP sensing is vital for monitoring its concentration in both industrial and biological contexts.

Traditional HP sensors based on dyes and enzymes often suffer from instability and irreversibility. In contrast, luminescent inorganic nanocrystals offer a promising alternative. Specifically, undoped (CeO_{2-x}) and Eu^{3+}-doped ($CeO_{2-x}:Eu^{3+}$) colloidal ceria nanocrystals facilitate HP detection through the reversible quenching of their luminescence bands at 590 nm (Eu^{3+}) and 430 nm (Ce^{3+}) [3]. Studying the quenching and recovery behavior of these luminescence bands during interactions with HP sheds light on the underlying mechanisms of HP detection by these nanoparticles.

CeO_{2-x} and $CeO_{2-x}:Eu^{3+}$ luminescent sensors demonstrate reversible detection capabilities, with their recovery rates significantly accelerated by increased temperature and continuous UV irradiation. However, the introduction of Eu^{3+} ions, while beneficial for luminescence properties, negatively impacts the catalase-like activity of CeO_{2-x} nanoparticles and diminishes their antioxidant efficacy. This trade-off must be considered when deploying these sensors in biological environments.

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