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The NANO-2024 Conference was organized by the Institute of Physics of NAS of Ukraine with the participation of the University of Tartu (Estonia), the Uzhhorod National University, University of Turin (Italy) and Pierre and Marie Curie University – Paris 6 (France).

NANO-2024 is the 12th conference in the series of NANO-conferences initiated by the Institute of Physics of NAS of Ukraine in 2012 in the framework of FP7 Nanotwinning project. From year to year, they attract more attention and participants. In 2012, the first meeting was held in the format of International Summer School for young scientists «Nanotechnology: from fundamental research to innovations». The 2013 and 2014 conferences were organized in conjunction with the International Summer Schools for young scientists under the same title. In 2013, this event was attended by more than 300 scientists, in 2014-2017, 450 scientists took part and in 2018 it gathered above 650 participants. In 2021 conference was attended by more than 700 scientists from Ukraine, Poland, Italy, Estonia, France, Austria, Germany, Greece, Turkey, USA, Romania, Moldova, Czech Republic, Taiwan, Lithuania, Egypt, India, Algeria, Indonesia and other countries. In 2021 - 2023 the Organizer Committee has received more than 800 application forms from about 25 countries of the world each years.

The NANO-2024 conference brought together leading scientists and young researchers from many countries of the world. This year its topics were as follows: Nanobiotechnology for health-care; Nanochemistry and biotechnology; Nanocomposites and nanomaterials; Nanoobjects microscopy; Nanooptics and photonics; Nanoplasmonics and surface enhanced spectroscopy; Nanoscale physics; Nanostructured surfaces; Physico-chemical nanomaterials science.

This year, the conference is organized with the support of the project “Knowhow Communities for Accelerating RTI Transfer in the Danube Region” (RTIT>>), DRP0200330.

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Catalase-like hydrogen peroxide decomposition by $\text{GdVO}_4:\text{Eu}^{3+}$ nanocrystals

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Hydrogen peroxide (H_2O_2) is a member of the reactive oxygen species family and plays a critical role in numerous redox metabolism reactions and cellular processes. It is considered a key component in the homeostatic metabolism of cells, mediating various physiological processes. However, the Fenton reaction between H_2O_2 and Fe^{2+} ions is a major cause of biomolecule oxidation reactions, leading to the formation of highly reactive hydroxyl radicals ($\bullet\text{OH}$). Therefore, there is significant interest in preventive antioxidants that can react with H_2O_2 without generating free radicals like $\bullet\text{OH}$.

In the present study, we report on $\text{GdVO}_4:\text{Eu}^{3+}$ nanoparticles (NPs) as prospective preventive nanozymes and analyze the mechanism of H_2O_2 decomposition by $\text{GdVO}_4:\text{Eu}^{3+}$ NPs in aqueous solutions using optical spectroscopy techniques. The synthesized $\text{GdVO}_4:\text{Eu}^{3+}$ NPs were characterized by TEM, HR-TEM, XRD and XPS methods. It was revealed that in aqueous solutions, $\text{GdVO}_4:\text{Eu}^{3+}$ NPs form individual crystalline spheroids with lengths of 12.1 nm and diameters of 5.8 nm. The kinetics of H_2O_2 decomposition by $\text{GdVO}_4:\text{Eu}^{3+}$ NPs in aqueous solutions was studied using optical spectroscopy techniques, and the potential for Fenton- and catalase-like reactions in this system was analyzed.

The obtained results indicate that a Fenton-like reaction involving $\text{V}^{4+}/\text{V}^{3+}$ ions, which are present in high amounts on the surface of $\text{GdVO}_4:\text{Eu}^{3+}$ NPs, and the generation of $\bullet\text{OH}$ radicals is not a likely scenario in this system. Instead, the primary mechanism appears to involve catalase-like reactions that facilitate $\text{V}^{4+} \leftrightarrow \text{V}^{5+}$ and $\text{V}^{3+} \leftrightarrow \text{V}^{4+}$ redox cycling, leading to effective H_2O_2 decomposition. Additionally, the rate of the H_2O_2 oxidation reaction is evidently higher than that of H_2O_2 reduction, as the V^{5+} to V^{4+} reduction is clearly detected in both optical and XPS spectra.

Therefore, $\text{GdVO}_4:\text{Eu}^{3+}$ NPs could serve as a promising preventive antioxidant for H_2O_2 decomposition via catalase-like mechanism.

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