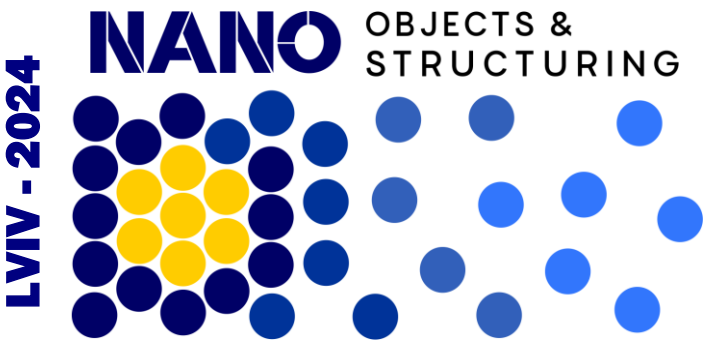
Ministry of Education and Science of Ukraine

Ivan Franko National University of Lviv
Faculty of Chemistry

Shevchenko Scientific Society

The National Academy of Sciences of Ukraine



III[rd] INTERNATIONAL RESEARCH and PRACTICE CONFERENCE «NANOOBJECTS & NANOSTRUCTURING» (N&N–2024)

October 7–10, 2024, Lviv, Ukraine

PROCEEDINGS

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III[rd] International Research and Practice Conference «Nanoobjects & Nanostructuring» (N&N–2024). October 7–10, 2024, Lviv, Ukraine : Proceedings / Ivan Franko National University of Lviv; Shevchenko Scientific Society; O. Reshetnyak, L. Boichyshyn, I. Marchuk (Eds.). – Lviv: Research and Publishing Center of the Shevchenko Scientific Society, 2024. – 118 + *xiv* p.

III[rd] International Research and Practice Conference «Nanoobjects & Nanostructuring» (N&N–2024) was held at Ivan Franko National University of Lviv on October 7–10, 2024. This Proceedings contains the results of studies, curried out in the Ukrainian universities and research Institutes of the National Academy of the Sciences of Ukraine, and also scientific centres of Cyprus, Czech Republic, France, Germany, Lithuania, India, Iceland, Poland, Slovak Republic, Spain, Switzerland, Ukraine, USA in the following fields: physical chemistry of nanosized and nanostructured materials; nanostructuring in 0D–3D systems: thermodynamic and kinetic aspects; synthesis and characterisation of nano-objects; organic and inorganic nanomaterials, supramolecular chemistry; application of nanostructurized systems.

In the author's edition

$GdVO_4:Eu^{3+}$ NANOCRYSTALS AS CATALASE MIMICS FOR HYDROGEN PEROXIDE DECOMPOSITION

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Hydrogen peroxide (H_2O_2) belongs to the family of reactive oxygen species and is vital for many redox metabolic reactions and cellular activities. It plays an important role in maintaining cellular homeostasis and influencing various physiological functions [1]. However, the reaction known as Fenton's reaction, which occurs between H_2O_2 and Fe^{2+} ions, is a significant contributor to the oxidation of biomolecules, resulting in the production of highly reactive hydroxyl radicals (•OH). This has led to increased interest in the development of preventive antioxidants that can interact with H_2O_2 without forming harmful radicals such as •OH [2].

In this research, we explore the potential of $GdVO_4:Eu^{3+}$ nanocrystals (NCs) as preventive nanozymes and investigate the mechanism of H_2O_2 decomposition facilitated by these nanoparticles in aqueous solutions, employing optical spectroscopy techniques. We assessed the kinetics of H_2O_2 decomposition by $GdVO_4:Eu^{3+}$ NCs in aqueous media and analyzed the likelihood of reactions similar to Fenton and catalase processes within this system.

The findings suggest that a Fenton-like mechanism, involving V^{4+}/V^{3+} ions, which are abundant on the surface of $GdVO_4:Eu^{3+}$ H_2O_2 decomposition, is unlikely to produce •OH radicals in this context. Rather, the predominant mechanism appears to involve catalase-like activity that promotes redox cycling between $V^{4+} \leftrightarrow V^{5+}$ and $V^{3+} \leftrightarrow V^{4+}$, facilitating effective decomposition of H_2O_2. Moreover, the rate of H_2O_2 oxidation is significantly higher than that of its reduction, as evidenced by the detection of V^{5+} to V^{4+} reduction in both optical and X-ray photoelectron spectroscopy (XPS) data.

In conclusion, $GdVO_4:Eu^{3+}$ NCs hold promise as effective preventive antioxidants for H_2O_2 decomposition through mechanisms akin to catalase activity.

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[1] N. Di Marzo, E. Chisci, R. Giovannoni. The Role of Hydrogen Peroxide in Redox-Dependent Signaling // Homeostatic and Pathological Responses in Mammalian Cells. – 2018. – 7. – P. 156.