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PREFACE

Preface

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Special Issue Foreword from Guest Editors

Dear Colleagues,

We are pleased to present this Special Issue *"Nano- and Photo- Catalysis in Current Chemistry: Possibilities and Challenges"* focused on current trends and innovation in catalysis. Catalysis plays a crucial role in current chemistry and about 90 % of the volume of modern chemical production is based on catalytic processes. Catalysts speed up chemical reactions by reducing activation energy, while the catalysts themselves remain unchanged throughout the reaction. This is especially important in industry, where catalysts increase process efficiency, reduce production costs, and enable chemical transformations that would not normally occur. Additionally, catalysis promotes the development of environmentally friendly technologies by minimizing harmful emissions. As a result, the chemical industry becomes more sustainable and environmentally friendly.

In this Special Issue, authors from countries such as China, Russia, Czech Republic, Azerbaijan, Uzbekistan and Kazakhstan share their 14 papers in the field of catalysis with readers of the *Eurasian Journal of Chemistry*.

The article by Professor **Xintai Su** from *South China University of Technology (Guangzhou, China) "Thermal Catalytic Production of Potassium Humate Fertilizer from Tobacco Straw and Its Performance in Wheat Hydroponics"* focuses on the production of artificial humic acid from waste biomass and considers its contribution to agricultural productivity. In this study, potassium humate was obtained from agricultural waste tobacco straw by thermal catalysis using environmentally friendly Fe_2O_3 as a catalyst. This study provides a green and simple technology for the resourceful utilization of tobacco straw to produce high value-added potassium humate, and enriches the source of raw materials for potassium humate, expanding its application in the field of crop growth.

Professor **Gulzhian I. Dzhardimalieva** (*Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry, Russian Academy of Sciences, Chernogolovka, Moscow region, Russia*), professor **Kamila A. Kydralieva** (*Moscow Aviation Institute, Moscow, Russia*) and coauthors presented research paper "A Statistical Design Approach for an Effective Catalyst in the Fenton Reaction in Case of Fe_3O_4-MOF MIL-88b (Fe) in Methylene Blue Degradation Kinetics", in which composites containing metal-organic framework MIL88b(Fe), nanoparticles magnetite (Fe_3O_4) or maghemite (γ-Fe_2O_3) modified by humic acids or ascorbic acid were synthesized and tested in the decomposition reaction of methylene blue. The prognostic model based on multivariate correlation analysis was used by the authors. It was shown that only the total concentration of released iron ions is a significant factor influencing the kinetics of the Fenton reaction.

Professor **Murzabek I. Baikenov** from *Karaganda Buketov University (Karaganda, Kazakhstan)* with co-authors determined the optimal conditions for demetallization of the heavy fraction of coal tar from Shu-

barkol Komir JSC by means of full factorial experiment. It was established that the optimal conditions for demetallization are equal to 0.04 ratio of the "Coal shale" catalytic additive to the heavy fraction of coal tar with boiling point above 300 °C, process temperature in the range of 420–430 °C, duration from 20 to 30 minutes and initial pressure between 3 and 5 MPa. Experiments conducted under these conditions showed a degree of demetallization of 87–89 %.

A mini-review by Professor **Sarkyt E. Kudaibergenov** *(Institute of Polymer Materials and Technology, Almaty, Kazakhstan)* briefly discusses the catalytic properties of polyampholytes, polyampholyte-metal complexes, polyampholyte-metal nanoparticles and polyampholyte-catalase conjugates. Special focus is given to amphoteric hydrogels and cryogels that encapsulate metal nanoparticles or enzymes. Additionally, the review explores the potential of light-driven hydrogen and oxygen evolution reactions from water, facilitated by metal nanoparticles within amphoteric hydrogels in the presence of photosensitizers.

Professor **Abduali Bayeshov** from *National Center on Complex Processing of Mineral Raw Materials of the Republic of Kazakhstan (Almaty, Kazakhstan)* with co-authors summarized the results of their pioneering research using the redox Ti (IV)-Ti (III) system, which demonstrates a catalytic effect on the cathodic reduction of selenium (VI), copper (II), platinum (IV), palladium (IV), bismuth, arsenic (V) ions, uranium (VI), as well as manganese dioxide suspension. It was demonstrated that in the presence of the redox Ti (IV)-Ti (III) system, hard-to-reduce selenate ions can be reduced at room temperature. The catalytic action of the Ti(IV)-Ti(III) redox system was demonstrated and the reaction mechanism was established.

The article "Effects of Selenite Ions on a Luminescence Enzymatic System" by Professor **Nadezhda S. Kudryasheva** (*Siberian Federal University, Krasnoyarsk, Russia*) and coauthors is focused on the biochemical and physicochemical aspects of toxicity of a redox-active compound in live organisms. Sodium selenite (Na_2SeO_3) was chosen as a model redox-active compound; a coupled enzymatic system from luminous marine bacteria was applied to imitate a biochemical process. It was demonstrated that Na_2SeO_3 suppressed bioluminescence of the enzyme system; the effective inhibition concentration was 10^{-2} M.

Researchers from *Lomonosov Moscow State University, Moscow, Russia* (Doctor **Gennadii A. Badun**) and from *Siberian Federal University, Krasnoyarsk, Russia* (Professors **Grigoriy N. Churilov**, **Nadezhda S. Kudryasheva** with others) studied radioprotective properties of fullerenol $C_{60,70}O_y(OH)_x$, ($x+y$ = 24–28), a water-soluble polyhydroxylated fullerene derivative with an electron-deficient aromatic carbon structure. Tritium, a radionuclide of low decay energy, was selected to simulate an exposure to low-dose irradiation (< 0.05 Gy), and luminous marine bacteria *Photobacterium phosporeum* was used as a model cellular object to monitor radiation bioeffects; the bioluminescence intensity of the bacteria was used as a tested biological parameter. It was found, what tritium activated the bacterial luminescence; the addition of fullerenol ($< 3 \cdot 10^{-3}$ g/L) "mitigated" the activation, thus revealing the radioprotective capacity of fullerenol for the marine microorganism.

Authors from *Institute of Catalysis and Inorganic Chemistry named after acad. M. Nagiyev of Ministry of Science and Education of Republic of Azerbaijan, Baku, Azerbaijan* (Professor **Yuriy N. Litvishkov** and Drs. **Nargalam M. Hasanguliyeva, Ninel V. Shakunova**) studied the activity of mono- and di-substituted cobalt and nickel ferrites prepared by microwave solid-phase synthesis was studied in the reaction of liquid-phase oxidation of m-xylene to m-toluic acid. It was established that among the tested samples, the di-substituted ferrites of spinel structure with the composition of $Ni_{0,6}Co_{0,4}Fe_2O_4$ have the shortest induction period and the highest initial rate of oxygen absorption.

Professor **Gulzhian I. Dzhardimalieva** (*Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry, Russian Academy of Sciences, Chernogolovka, Russia*) and coauthors studied rational synthesis of UiO-66 and its application in the hydrogenation reaction of p-chloronitrobenzene. The effects of reaction temperature, linker volume concentration and solvent type on the specific surface area and thermal properties were evaluated. The composition, structure and physicochemical properties of the obtained compounds by IR spectroscopy, TGA and XRD analysis were also studied.

Synthesis and electrocatalytic activity of copper nanoparticles supported on nickel ferrite were studied by Professor **Nina M. Ivanova** *(LLP "Institute of Organic Synthesis and Coal Chemistry of Kazakhstan Republic", Karaganda, Kazakhstan)* and coauthors. $Cu(x)/NiFe_2O_4(y)$ magnetic composites with different component ratios were prepared by chemical reduction of copper cations in the presence of sonicated nickel ferrite and characterized by X-ray diffraction spectroscopy and scanning electron microscopy. The electrocatalytic activity of $Cu(x)/NiFe_2O_4(y)$ composites deposited on a cathode was investigated in the electrohydrogenation of acetophenone (APh). It was shown that the electrocatalytic activity of these composites appears starting from the percentage ratio of their components x:y = 40:60.

Preparation and characterization of copper nanoparticles stabilized by poly(vinyl alcohol) for catalytic oxidation of 1-propanol were studied by the authors from *Institute of Polymer Materials and Technology, Almaty, Kazakhstan* (Professors **Sarkyt E. Kudaibergenov**, **Dina N. Akbayeva)** with coauthors from Al-Farabi Kazakh National University, *Almaty, Kazakhstan.* The aqueous solution of copper (II) complex of poly(vinyl alcohol) (PVA-Cu(II)) was characterized by conductimetric titration, UV-Vis spectroscopy and FTIR. The optimum catalyst mass and reaction time were found for the conversion of 1-propanol to propionaldehyde with yields ranging from 61.4 % to 87.8 %.

Professor **Kamila A. Kydralieva** (*Moscow Aviation Institute, Moscow, Russia*) and coauthors presented study of magnetically separable Fe_3O_4/γ-Fe_2O_3@MIL-88b(Fe) and Fe_3O_4/γ-Fe_2O_3@NH_2-MIL-88b(Fe) composites for the photocatalytic degradation of Congo Red dye. These composites were characterized by elemental analysis, FTIR spectra, XRD patterns, magnetization curves, TGA profiles, nitrogen adsorption-desorption isotherms. Using ultraviolet-visible spectroscopy and Congo Red anionic azo dye as organic pollutant, composites' adsorption kinetics were observed and their photocatalytic activities were studied. As a result, Fe_3O_4/γ-Fe_2O_3@MIL-88b(Fe) and Fe_3O_4/γ-Fe_2O_3@NH_2-MIL-88b(Fe) were both capable photocatalysts for generating hydroxyl radicals from hydrogen peroxide (H_2O_2) through Fenton-like reaction with removal efficiencies of CR dye approaching 89 % and 95 %, respectively.

Associate Professor **Gulsym K. Burkeyeva** from *Karaganda Buketov University, Karaganda, Kazakhstan* with coauthors presented synthesis and investigation of catalytic properties of metal-polymer nanocomposites based on copolymers of polypropylene glycol fumarate phthalate and polypropylene glycol maleate phthalate, using acrylic acid and immobilized cobalt metal particles as catalysts. A classical reaction of the electrocatalytic hydrogenation of pyridine to piperidine was applied. SEM and dynamic light scattering were used to investigate the average size and dispersity of cobalt metal nanoparticles. The results of the studies indicated high catalytic activity of metal-polymer nanocomposites based on p-PGMPh–AA–Co^0 and p-PGFPh–AA–$Co^{0.}$

The team of authors led by Professor **Xintai Su** (*South China University of Technology, Guangzhou, Guangdong, China*) reported about construction of a series of Ag/AgCl@MIL-53(Fe) samples with different Fe:Ag ratios by hydrothermal methods and their use in the photocatalytic water oxidation reactions. XRD characterization showed the successful preparation of Ag/AgCl@MIL-53(Fe) heterostructure catalysts. The reaction results showed that sample AAM-2 (Fe:Ag=5:1) had the best photocatalytic water oxidation performance, with the highest TOF value of 0.14 mmol/(g·s) and quantum efficiency of 39.0 % under the conditions of catalyst mass of 1 mg and pH=9.0 for boric acid-borax buffer solution.

Dear Readers! In this Special Issue "*Nano- and Photo- Catalysis in Current Chemistry: Possibilities and Challenges"* you will find 14 papers in the field of catalysis involving researchers from China, Russia, Czech Republic, Azerbaijan, Uzbekistan and Kazakhstan. The Guest Editors of this Special Issue have invited new authors with interesting topics and hope that the collected articles will attract reader interest and expand the audience of the *Eurasian Journal of Chemistry*!

*Information about Guest Editors**

**The editors' names are presented in the following order: First Name, Middle Name and Last Name*

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