
# ABSTRACT BOOK

## International research and practice conference:

## NANOTECHNOLOGY AND NANOMATERIALS (NANO-2022)

25-27 August 2022
Lviv, Ukraine

# INTERNATIONAL RESEARCH AND PRACTICE CONFERENCE "NANOTECHNOLOGY AND NANOMATERIALS"

(The NANO-2022 Conference is dedicated to the International Year of Basic Sciences for Sustainable Development)

**25-27 of August 2022**

**Lviv, UKRAINE**

## Abstract book

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This book contains the abstracts of contributions presented at the International research and practice conference "Nanotechnology and Nanomaterials" (NANO-2022).

The NANO-2022 Conference was organized by the Institute of Physics of NAS of Ukraine with the participation of the University of Tartu (Estonia), the Lviv Polytechnic National University, University of Turin (Italy) and Pierre and Marie Curie University – Paris 6 (France).

NANO-2021 was the ninth conference in the series of NANO-conferences initiated by the Institute of Physics of NAS of Ukraine in 2012 in the framework of FP7 Nanotwining 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, Iran, India, Algeria, Indonesia and other countries. In 2021 the Organizer Committee has received more than 800 application forms from about 25 countries of the world.

The NANO-2022 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.

Website of the Nano-2022 conference: http://nano-conference.iop.kiev.ua

In order to support the formation of the communications between the scientific and innovation communities the EEN-Ukraine consortium together with EEN partners in Germany organized STARTUP2022 competition for selection 10 the best Ukrainian startups for participation in the Start-up BW Summit, Germany.

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# The effect of cerium dioxide nanocrystals on the oxidative stress parameters in irradiated human skin mesenchymal stem cells-embedded scaffolds

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Cerium dioxide nanocrystals ($CeO_2$) are today one of the most promising classes of antioxidant materials.

The aim of the study was to substantiate experimentally *in vitro* the possibility of using $CeO_2$ nanocrystals as an antioxidant for cell therapy of radiation burns.

Spherical $CeO_2$ nanoparticles (D=1-2 nm) were synthesized in the Nanostructured Materials Department named by Yu.V. Malyukin of Institute for Scintillation Materials of NAS of Ukraine.

The work was carried out on human skin mesenchymal stem cells-embedded scaffolds (hsMSCs-scaffolds). Cells subcultured until passage 3 (Eppendorf Galaxy 14S, 37°C, 5%$CO_2$, 99% RH) with viability of 86% (Invitrogen Countess Counter) were then seeded on a highly porous 3D cell culture polystyrene scaffold (Alvetex Scaffold, 96 well, REPROCELL) and cultured for 10 days until the culture density of 84%. 1 hour prior to irradiation, a suspension of nanoparticles was added to the culture medium (αMEM + 10% FBS, Gibco) to a final concentration of 10, 20 and 40 nM), and incubated for 1 hour (Eppendorf Galaxy 14S, 37°C, 5% $CO_2$, 99% RH).

After replacing the medium with nanoparticles free one, the cells were irradiated on the gamma complex Rokus AM ($Co^{60}$). The dose of irradiation was 0.75 Gy (104kV, 9mA, 0.2 Gy/min, duration of irradiation – 225 sec).

Two and six hours after irradiation, the fluorescence imaging (Olympus FV10iLIV confocal microscope, cellSense software), fluorimetric determination (Biotek FL600 reader, KC4 software) of the concentration of reactive oxygen species (ROS) (DCFDA, Ex/Em=495/529 nm), lipid hydroperoxides (MitoPeDPP, Ex/Em=452/470 nm), determination of the degree of DNA fragmentation by comet

analysis (Mupid-exU System, Alpha Innotech Red™ Imaging System, CASPlab software), spectrophotometric determination (Biotek FL600 reader, KC4 software) of the enzymatic activity of superoxide dismutase and catalase (Abcam kits) were carried out in the hsMSCs - scaffolds.

It was shown that in the absence of irradiation, nanoparticles at concentrations of 10 and 20 nM do not cause changes in the studied parameters. The concentration of the nanoparticles 40 nM caused a decrease in cell viability by 7% after 6 hours of cultivation on a background of absence of changes in other parameters. This concentration also proved to be ineffective for maintaining the vitality of cells after irradiation - the number of living cells decreased both in the presence and absence of nanoparticles after 6 hours of cultivation by 28%. Pre-incubation with nanoparticles at a concentration of 10 and 20 nM resulted in an increase in the number of living cells in culture 6 hours after irradiation by 11% and 17%, respectively, compared with irradiated cells non- preincubated with nanoparticles.

In 2 and 6 hours after irradiation, the concentration of ROS and lipid hydroperoxides increased by 6.2 and 8.5 times, respectively, in the culture. The degree of fragmentation of nuclear DNA increased by 6.5 times. In this case, the activity of SOD and catalase decreased by 6 hours of observation for 3.6 and 5.8 times, respectively.

Pre-incubation with $CeO_2$ nanoparticles at all used concentrations resulted in a significant decrease in prooxidant indices in irradiated culture. Herewith, the most prominent protective effect was provided by the concentration of 20 nM – for 6th hour of cultivation after irradiation, the concentration of ROS and lipid hydroperoxides was respectively 46% and 29% less, and the activity of SOD and catalase was 71% and 108% higher than in irradiated culture without nanoparticles. At the same time, regardless of the concentration of nanoparticles, the degree of DNA fragmentation remained at the level of irradiated cells without nanoparticles, which apparently is either a consequence of long-term effects of ROS overproduction or the inability to fix defects by cell repair systems over the past observation time.

Thus, spherical nanoparticles $CeO_2$ (D=1-2 nm) at a concentration of 20 nM can be used in cell therapy of skin lesions to normalize the prooxidant-antioxidant balance.

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