



# 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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**The International research and practice conference “Nanotechnology and nanomaterials”** (NANO-2022). Abstract Book of participants of the International research and practice conference, 25–27 August 2022, Lviv. Edited by Dr. Olena Fesenko. – Kyiv: LLC APF POLYGRAPH SERVICE, 2022. – P. 542.

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 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, 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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## **Welcome to International Conference «NANOTECHNOLOGY AND NANOMATERIALS»!**

It gives me a great pleasure to welcome you all at the International Conference “Nanotechnology and nanomaterials” (NANO-2022) that will be held in Lviv from August 25 to 27, 2022. Its aim is to promote scientific contacts and discussions between researchers representing various fields.

Previous NANO Conferences, held in Ukraine in 2013-2021, allowed the participants, including young scientists, to familiarize with current research and application problems in this area and thus forward implementation of nanotechnologies into innovations meeting public needs. The events also gave the opportunity to young and early-career researchers to attend lectures of internationally recognized experts and roundtable discussions on the emerging fields in nanosciences and nanotechnologies.

Our previous International Conferences and Summer Schools received positive feedback from international experts and from the media. Now we are holding the 10th such meeting, for which we are deeply grateful to its indefatigable initiator and organizer, Dr. Olena Fesenko and all her assistants, as well as to the universities and institutes that hospitably welcome the participants.

This year above 600 registration forms have been received from scientists representing more than 30 countries. We especially appreciate the participation in the conference of our foreign colleagues, both those who attend here and those who communicate their works remotely.

The fruitful cooperation of scientists is highly important not only to science itself. It helps us to overcome political and war conflicts and misunderstandings and to find our just peaceful future, which is now vitally important not only to Ukraine but also to other countries.

I wish the participants of the Conference to successfully share and broaden their knowledge in nanoscience and nanotechnologies, to advance the networking and launch new contacts between academia and research players in this area and thus to create a good basis for further practical contributions.

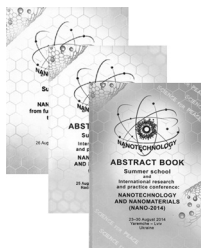
May good health serve us and promote creative success in our research!

Academician of NAS of Ukraine,  
Professor



**Anton G. Naumovets**

## Our publications



Abstracts Book of the 1st International Summer School (2012)

Abstracts Book of the 1st International Summer School and International Conference NANO 2013

Abstracts Book of the 2nd International Summer School and International Conference NANO 2014

Abstracts Book of the 3rd International Conference NANO-2015

Abstracts Book of the 4th International Conference NANO-2016

Abstracts Book of the 5th International Conference NANO-2017

Abstracts Book of the 6th International Conference NANO-2018

O. Fesenko, L. Yatsenko and M. Brodin et al. (eds.), Nanomaterials, Imaging techniques, Surface Studies, and Applications, Springer Proceedings in Physics 146, DOI: 10.1007/978-1-4614-7675-7, ©Springer Science+Business, Media, New York 2013

O. Fesenko, L. Yatsenko (eds.), Nanocomposites, Nanophotonics, Nanobiotechnology, and Applications, Springer Proceedings in Physics 156, DOI: 10.1007/978-3-319-0661-0, ©Springer International Publishing, Switzerland 2014

O. Fesenko, L. Yatsenko, Nanoplasmonics, Nano-Optics, Nanocomposites, and Surface Studies 167, DOI: 10.1007/978-3-319-18543-9, ©Springer International Publishing, Switzerland 2015

O. Fesenko, L. Yatsenko, Nanophysics, Nanophotonics, Surface Studies, and Applications 183, DOI: 10.1007/978-3-319-30737-4, ©Springer International Publishing, Switzerland 2016

O. Fesenko, L. Yatsenko, Nanocomposites, Nanostructures, and Their Applications 221, DOI: 10.1007/978-3-030-17759-1, ©Springer International Publishing, Switzerland 2019

O. Fesenko, L. Yatsenko, Nanophotonics, Nanooptics, Nanobiotechnology, and Their Applications 222, DOI: 10.1007/978-3-030-17755-3, ©Springer International Publishing, Switzerland 2019



Participants of International Summer Schools and International NANO Conferences - published their articles in Special Issue of Springer Open Journal "Nanoscale Research Letters" (in 2013, 2014 and 2015) dedicated to NANO Conferences. Impact Factor of Journal - 2.779.

In 2016-2018 it was also possible to publish an articles for participants of the NANO conference in Applied Nanoscience Journal, The European Physical Journal Plus (EPJ Plus) and Applied Sciences Journal (SN).

[www.springer.com/materials/nanotechnology/journal/11671](http://www.springer.com/materials/nanotechnology/journal/11671)

Also, since 2017 year it was possible to publish the articles for participants of NANO Conference in the Molecular Crystals and Liquid Crystals Journal

<https://www.tandfonline.com>

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**The Enterprise Europe Network (EEN)** is a service that provides support for Small and Medium-sized Enterprises (SMEs) with international ambitions. Co-funded by the European Union's COSME and Horizon 2020 programmes, the Network's aim is to

help businesses innovate and grow internationally.

The Enterprise Europe Network was launched on 7 February 2008 by former EU Commissioner Günter Verheugen. The Enterprise Europe Network combines the previous Euro Info Centres and the Innovation Relay Centres. From 2008 to 2014, the Network was co-financed by the EU's Competitiveness and Innovation Framework Programme (CIP), in cooperation with institutions at national and regional levels. From 2015-2020, the Network is co-financed under the European Union's programme for the competitiveness of SMEs (COSME) and Horizon 2020.

Under the responsibility of the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, the Enterprise Europe Network is managed by the Executive Agency for Small and Medium-sized Enterprises (EASME).

The Network is active in more than 70 countries worldwide. It brings together 6,000 experts from more than 600 member organisations, including:

- chambers of commerce and industry
- technology poles
- innovation support organisations
- universities and research institutes
- regional development organisations

Enterprise Europe Network innovation support services are available based on an assessment of the needs and development phase of the business.

At an entry level, Network services include:

- information on innovation-related policies, legislation and support programmes
- links with local innovation stakeholders
- information about access to local sources of funding/support

Network experts can provide one-to-one services to support innovation capacity building. Services include innovation audits, advice on intellectual property, marketing and access to finance.

Finally, the Network provides key account management services to businesses benefitting from the Horizon 2020 SME instrument programme, part of the European Innovation Council (EIC) pilot.

In 2017, Ukraine joined the European Enterprise Network (EEN) within the framework of the COSME program, which promotes the competitiveness and innovative development of SMEs, innovation organizations and institutes/universities. For this purpose in Ukraine was created a Consortium EEN-Ukraine, which included representatives of business and government agencies, as well as scientific organizations. The Coordinator of the EEN-Ukraine Consortium is Institute of Physics of NAS of Ukraine.

To contact EEN-Ukraine please follow the website

<http://www.iop.kiev.ua/~een/index-en.html>

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## Liquid crystalline substances doped with carbon nanotubes as a sensitive medium of the CO<sub>2</sub> sensor

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The creation of highly sensitive optical CO<sub>2</sub> in air sensors is an urgent problem, as it allows control of CO<sub>2</sub> content both indoors and in ambient air, where it's level usually 600... 1000 ppm.

We propose to use a liquid crystalline substance[1-3] (nemato-cholesterol mixture based on E7 with impurities of cholesterol), supplemented with multi-walled carbon nanotubes, as a sensitive element of the CO<sub>2</sub> sensor. The spectral characteristics of the liquid crystal mixture in the range of 400... 600 nm were studied. The content of carbon nanotubes varied in the range of 0.1... 0.5 wt.%. It is established that with increasing concentration in the range of 10... 100 mg/m<sup>3</sup> the minimum transmission shifts to the long-wavelength region of the spectrum. The maximum spectral sensitivity in this range is 6 nm/mg/m<sup>3</sup>. The investigated material can be used as a sensitive element of the optical CO<sub>2</sub> sensor.

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1. Mykytyuk, Z.M., Kremer, I.P., Ivakh, M., Diskovskiy, I.S., Khomyak, S.V. Optical sensor with liquid crystal sensitive element for monitoring acetone vapor during exhalation// *Molecular Crystals and Liquid Crystals*. - 2021, 721(1), pp. 24–29.

2. M. Vistak, Z. Mykytyuk, F. Vezyr, V. Polishchuk, *Molecular Crystals and Liquid Crystals* 672(1), 67 (2018).

3. R.Politansryi, M.Vistak, G.Barylo, A.Andrushak, *Optical Materials*, 102, art.no.109782, (2020).

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The **Enterprise Europe Network** is a service that provides support for Small and Medium-sized Enterprises (SMEs) with international ambitions. Co-funded by the European Union's COSME and Horizon 2020 programmes, the Network's aim is to help businesses innovate and grow internationally.

The Enterprise Europe Network was launched on 7 February 2008 by former EU Commissioner Günter Verheugen. The Enterprise Europe Network combines the previous Euro Info Centres and the Innovation Relay Centres. From 2008 to 2014, the Network was co-financed by the EU's Competitiveness and Innovation Framework Programme (CIP), in cooperation with institutions at national and regional levels. From 2015-2020, the Network is co-financed under the European Union's programme for the competitiveness of SMEs [6] (COSME) and Horizon 2020[7].

Under the responsibility of the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, the Enterprise Europe Network is managed by the Executive Agency for Small and Medium-sized Enterprises (EASME).

The Network is active in more than 60 countries worldwide. It brings together 3,000 experts from more than 600 member organisations, including:

- chambers of commerce and industry
- technology poles
- innovation support organisations
- universities and research institutes
- regional development organisations

Enterprise Europe Network advisory services support businesses seeking to expand into international markets. The services cover a wide range of regulatory areas and market intelligence:

- Compliance with EU regulations and standards (e.g. CE marking)
- Access to international markets – market intelligence and capacity building
- International public contracts –access to cross-border procurement and EU tender opportunities
  - National and regional finance and funding – identification of sources of finance and investor-readiness training
    - EU funding schemes and application support
    - Intellectual property rights (IPR) – patents and IPR applications and exploitation strategies
      - Energy and resource efficiency – identification of technologies and finance opportunities
      - Management improvement – capacity building

Enterprise Europe Network innovation support services[4] are available based on an assessment of the needs and development phase of the business.

At an entry level, Network services include:

- information on innovation-related policies, legislation and support programmes
- links with local innovation stakeholders
- information about access to local sources of funding/support

Network experts can provide one-to-one services to support innovation capacity building. Services include innovation audits, advice on intellectual property, marketing and access to finance.

Finally, the Network provides key account management services to businesses benefitting from the Horizon 2020 SME instrument programme[5], part of the European Innovation Council (EIC) pilot.

In 2017, Ukraine joined the European Enterprise Entrepreneurship Network (EEN) within the framework of the COSME program, which promotes the competitiveness and innovative development of small and medium-sized enterprises, innovation organizations and institutes / universities. For this purpose in Ukraine was created a Consortium EEN-Ukraine , which included representatives of business and government agencies, as well as scientific organizations

To contact EEN-Ukraine please follow the website

<http://www.iop.kiev.ua/~een/index-en.html> or page of Facebook

<https://www.facebook.com/EnterpriseEuropeNetworkEU>.

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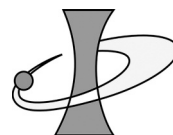
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(NANO-2022)**

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Свідоцтво про внесення суб'єкта видавничої справи до державного реєстру видавців, виготовників і розповсюджувачів видавничої продукції серія ДК № 3900 від 14.10.2010

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

## Our publications



Abstracts Book of the 1st International Summer School (2012)  
 Abstracts Book of the 1st International Summer School and International Conference NANO-2013  
 Abstracts Book of the 2-nd International Summer School and International Conference NANO-2014  
 Abstracts Book of the 3-rd International Conference NANO-2015  
 Abstracts Book of the 4-th International Conference NANO-2016  
 Abstracts Book of the 5-th International Conference NANO-2017  
 Abstracts Book of the 6-th International Conference NANO-2018  
 Abstracts Book of the 7-th International Conference NANO-2019

O. Fesenko, L. Yatsenko and M. Brodin et al. (eds.), Nanomaterials, Imaging techniques, Surface Studies, and Applications, Springer Proceedings in Physics 146, DOI: 10.1007/978-1-4614-7675-7, ©Springer Science+Business, Media, New York 2013

O. Fesenko, L. Yatsenko (eds.), Nanocomposites, Nanophotonics, Nanobiotechnology, and Applications, Springer Proceedings in Physics 156, DOI: 10.1007/978-3-319-06611-0, ©Springer International Publishing, Switzerland 2014

O. Fesenko, L. Yatsenko, Nanoplasmonics, Nano-Optics, Nanocomposites, and Surface Studies 167, DOI: 10.1007/978-3-319-18543-9, ©Springer International Publishing, Switzerland 2015

O. Fesenko, L. Yatsenko, Nanophysics, Nanophotonics, Surface Studies, and Applications 183, DOI: 10.1007/978-3-319-30737-4, ©Springer International Publishing, Switzerland 2016

Participants of International Summer Schools and International NANO Conferences – published their articles in Special Issue of Springer Open Journal “Nanoscale Research Letters” (in 2013, 2014 and 2015) dedicated to NANO Conferences. Impact Factor of Journal – 2.779.

[www.springer.com/materials/nanotechnology/journal/11671](http://www.springer.com/materials/nanotechnology/journal/11671)

## Our Partners:

The Enterprise Europe Network is the world's largest support network for Small and Medium-sized Enterprises (SMEs) with international ambitions. Co-funded by the European Union's COSME and Horizon 2020 programmes, the Network's aim is to help businesses innovate and grow internationally. The representative EEN in Ukraine - EEN-Ukraine Consortium. [www.ec.europa.eu](http://www.ec.europa.eu)

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