



# ABSTRACT BOOK

International research  
and practice conference:

**NANOTECHNOLOGY  
AND NANOMATERIALS  
(NANO-2020)**

26-29 August 2020  
Lviv, Ukraine

**INTERNATIONAL RESEARCH  
AND PRACTICE CONFERENCE  
“NANOTECHNOLOGY  
AND NANOMATERIALS”**

**(NANO-2020)**

**26-29 August 2020**

**Lviv, UKRAINE**

**Abstract book**

**The International research and practice conference “Nanotechnology and nanomaterials” (NANO-2020).** Abstract Book of participants of the International research and practice conference, 26 – 29 August 2020, Lviv. Edited by Dr. Olena Fesenko. – Kyiv: LLC «Computer-publishing, information center», 2020. – P. 552.

This book contains the abstracts of contributions presented at the International research and practice conference “Nanotechnology and Nanomaterials” (NANO-2020).

The NANO-2020 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-2020 was the eight 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 2019 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 2019 the Organizer Committee has received more than 800 application forms from about 25 countries of the world.

The NANO-2020 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-2020 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 created the networking online event "Virtual NANO-2020", which was held on 26-29 August 2020 on the platform <https://virtual-nano-2020.b2match.io/>

## **Impedance analysis of PEDOT:PSS/CNT Composites Below Percolation Threshold**

***Karbovnyk I.<sup>1</sup>, Klym H.<sup>2</sup>, Chalyy D.<sup>3</sup>,  
Lukashevych D.<sup>3</sup>, Zhydenko I.<sup>3</sup>***

*<sup>1</sup> Ivan Franko National University of Lviv,  
Dragomanova Str., 50, Lviv, 79005, Ukraine,  
E-mail: ivan\_karbovnyck@yahoo.com*

*<sup>2</sup> Lviv National Polytechnic University, Lviv, Ukraine*

*<sup>3</sup> Lviv State University of Life Safety, Lviv, Ukraine*

Polymer nanocomposites such as those based on PEDOT:PSS matrix filled with carbon nanomaterials are typically known to have low percolation threshold. That means that even small loadings of conductive nanotubes having high aspect ratio already lead to the formation of at least one (although usually more) conductive pathway. While shape, size and geometry of filler basically determine whether electrical percolation occurs another important factor is the dispersion of nanofiller inside the matrix, which is not easily achievable and often prevent observing low percolation threshold.

In this presentation we analyze electrical response of PEDOT:PSS polymer layers with incorporated single-walled and multi-walled nanotubes in amounts that hypothetically should be sufficient for percolation to occur. Morphological analysis by scanning electron microscopy, however, indicates the formation of isolated bundles inside the polymer matrix and low probability of connection between adjacent bundles.

To study how such nanocomposite behaves under AC electrical excitation we used impedance spectroscopy as a tool. Impedance spectra in the range of frequencies from 100 Hz to 1 MHz were measured with Keysight E4990A analyzer capable of measuring absolute value of the sample impedance in the range from  $10^{-1}$  to  $10^9$  Ohms with less than 1% error.

Based on collected impedance data for nanocomposite samples with different concentration of incorporated nanotubes (both single-walled and multi-walled ones) equivalent circuit models describing conductivity processes in these materials are proposed and discussed.