## PREFACE

Petro Mykhailovych Tomchuk was a bright example of a Ukrainian theoretical physicist, whose life credo was science. Throughout his extensive scientific career, which was consistently linked to the Institute of Physics of the National Academy of Sciences of Ukraine (IP NASU), Petro Tomchuk worked on a diverse range of problems spanning various domains of theoretical physics. The main areas of his research concerned the physics of semiconductors, metal island films and nanoparticles, liquid crystals and colloids, and molecular structures with hydrogen bonds. Those studies had a common feature: they dealt with non-equilibrium processes and systems, which Petro Mykhailovych was interested in. Kinetic theory, distribution function, fluctuations, microscopic approach, density matrix – these are basic concepts that P.M. Tomchuk most often operated with.

With the loss of Petro Tomchuk, the Ukrainian scientific community lost an outstanding physicist, a democratic teacher, and an extraordinary personality. However, Petro Mykhailovych left a significant scientific legacy, which future generations of physicists can utilize to continue his research. Our intention to dedicate this issue of the Ukrainian Journal of Physics (UJP) to the memory of Petro Tomchuk is motivated by the desire, firstly, to properly honor his memory and, secondly, to provide an impetus and basis for the further development of his scientific ideas, concepts, approaches, and theories.

This memorial issue opens with notes on the life path of Petro Mykhailovych, written by his son Bohdan. The next is a review article about Petro Mykhailovych's scientific legacy, written by the employees of the Department of Theoretical Physics at the IP NASU, which Petro Mykhailovych headed for 50 years. The article reveals the main results obtained by P.M. Tomchuk while studying kinetic and optical phenomena in semiconductors, the carrier transport in semiconductor structures, the electron-lattice energy exchange and hot electrons in semiconductors and island metal films, optical properties of metal nanoparticles and their ensembles, liquid crystals and colloids, as well as molecular structures with hydrogen bonds.

Undoubtedly important is the article by Ye.D. Bilotsky, who worked for a long time together with P.M. Tomchuk, on the mechanism of focusing and amplification of acoustic waves created by metal nanoparticles in a crystal lattice under the influence of ultrashort laser pulses. Ye.D. Bilotsky began writing this work together with Petro Mykhailovych, but he had to finish it alone.

In B.I. Lev's article on the Coulomb elastic interaction in liquid crystal colloids, the author summarizes his joint work with P.M. Tomchuk on this topic. The same is valid for A.O. Snarsky's article on the effective properties of macroscopically inhomogeneous media with restructuring.

In the article by O.Yu. Semchuk and co-authors, the process of resonance energy transfer from impurity dye molecules to a semiconductor carbon nanotube is considered; this is another type of nanosystems that P.M. Tomchuk was interested in. And in the article by A.V. Korotun, an equivalent-spheroid approach is proposed to describe resonant optical phenomena in metal dumbbell-shaped nanoparticles. This work is directly related to the works and results of P.M. Tomchuk on the optical properties of spheroidal metal nanoparticles.

Another class of nanosystems with wide practical applications includes nanopowders of materials with ferromagnetic properties, in particular, the so-called multiferroics, which demonstrate simultaneous ferroelectric and magnetic ordering. The article presented in this issue by a group of authors from the IP NASU and the Taras Shevchenko National University of Kyiv summarizes the results of the study of electrophysical properties, phase diagrams, and charge carrier transport in nanopowders of one of such materials.

V.I. Pentegov and O.V. Semenov are the employees of the Department of Physics of Magnetic Phenomena at the IP NASU. They worked for a long time under the supervision of the authoritative theoretical physicist E.A. Pashytsky, with whom Petro Mykhailovych collaborated at the beginning of his scientific career. In this issue, they presented an interesting paper on the possibility of Cooper pairing and superconductivity in the surface areas of noble metals.

I.S. Gandzha, O.V. Kliushnichenko, and S.P. Lukyanets presented an interesting paper on the activation mechanism of the socio-economic system collapse during the crisis spread and the corresponding exit strategy. P.M. Tomchuk often used activation mechanisms to build his theoretical models, in particular, the proton polaron model, when explaining the mechanism of hopping transport of charge carriers in molecular chains with hydrogen bonds. For technical reasons, this paper will appear in one of the next UJP issues.

Finally, this memorial issue contains the full bibliographical list of Petro Tomchuk's scientific works with more than 300 references.

We are grateful to all the authors who responded to our invitation and submitted their articles to this UJP issue. Special thanks to the editorial staff who diligently prepared this issue for publication.

To summarize, on behalf of the UJP editorial team, we express our deep respect and gratitude to the Armed Forces of Ukraine and all those who fought and continue to fight for the freedom and independence of our nation and country. Petro Mykhailovych Tomchuk was a sincere patriot of Ukraine.

*Ivan GANDZHA, Bogdan LEV*