Review of proposal for prolongation of the theme entitled "Radiation physics, radiochemistry, and nanotechnology investigations using beams of accelerated heavy ions"

The prolongation of the theme is planned for the period of 2022-2023 and constitutes a continuation of applied research activity with the FLNR heavy ion accelerators. It is seen from the Report on the execution of program 04-5-1131 -2017/2021, the activity in the framework of the above theme have brought many interesting results. As it had been planned, a significant improvement of the instrumentation park was made in 2017-2021, covering the entire range of equipment, and specifically modern high precision instruments for the study of materials modifications under heavy ion bombardment and the development of micro- and nanostructured materials of practical importance. This progress in the instrumentation made it possible to formulate new research goals on a higher scientific and practical level, and the relevant research works are in progress at present.

Being an expert in membrane science, I would like to make an emphasis on the activity devoted to the development of new materials for separation processes. FLNR is a well-known leader in the field of track membranes – the specific type of membranes for microfiltration and ultrafiltration. The past 5 years of research and development work yielded some revolutionary results which showed that the ion track based method has a great potential for the creation of new materials capable to separate ions. This breakthrough is due to the unique properties of track-etched nanopore membranes. First, a novel electro-baromembrane method for ion separation is suggested. An electric field and a pressure field are superimposed on a nanoporous membrane so that the electric and pressure driving forces act on a competing ion in opposite directions. A very high permselectivity coefficient between potassium and rhodamine cations was obtained along with a quite high flux of the potassium ions, when using a track-etched membrane with a pore diameter of 40 nm. A significant advantage of the proposed method is that it allows separation of the ions with the same charge when consuming low energy, which is almost impossible using other membrane technique. Another highly promising technology is the fabrication of nanopore membranes from ion-irradiated polymer foils not using traditional chemical etching with aggressive chemicals. It has been shown that the controlled photo-oxidation and liquid extraction (instead of the chemical etching) allows obtaining cation-selective membranes with a high selectivity and permeability. In both cases the FLNR team contributed to the above achievements at the frontier of modern membrane technologies.

As it is seen from the Report on the execution of the theme, the FLNR team actively co-operates with many research groups in member countries, but I would like to underline the

effectiveness of co-operation with the Kuban State University which I represent. My colleagues and I have obtained valuable results when applying track-etched membranes prepared by the FLNR team for a novel process of electro-baromembrane ion separation. We look forward to the continuation of this fruitful co-operation, in particular aimed at the optimization of track-etched membranes for more selective separation of different ions with the same electric charge.

In summary, investigations planned in the framework of the proposed theme are novel and of current importance; they also satisfy contemporary demands and have a significant scientific value. The team possesses all resources needed to implement the planned work.

I strongly support the proposal for the prolongation of this theme.

Doctor of Sciences in Chemistry
Professor
Kuban State University, Krasnodar, Russia

Victor V. Nikonenko

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