

Description for general public (in English)

Topological insulators are electronic materials that conduct electricity very well on the surface and inside are insulators. We can imagine that it is as if the surface of the insulator, which does not conduct current, is covered with a very thin layer of a good conductor, gold or copper. It was recently found that the grown in the Institute of Physics PAS crystals in which the atoms of lead, tin and selenium are arranged in perfect order in a rock salt structure belong to a certain class of such topological insulators, namely to topological crystalline insulators. This discovery was published in 2012 in the prestigious journal Nature Materials. In our topological crystalline insulators a conductive surface occurs spontaneously, requires no other material, cannot be removed and can conduct electricity even better than gold. It is expected that due to the materials of this type it will be possible to achieve much higher current flow and a considerable reduction of the heat release in micro- and nano-electronic systems. In addition, the exotic quantum properties of these materials can be important in spintronics - a new branch of electronics, also developed in our Institute. Namely, it is known that in this group of materials doping with magnetic ions, manganese, leads to ferromagnetism. The possibility of coexistence of ferromagnetism and topological states is one of the most intriguing research challenges in spintronics. These types of issues are going to be tested in this project. The theoretical studies of our group are aimed at a detailed description of the properties of topological crystalline insulators, in particular at checking how various factors, including defects in the structure and composition, can affect these properties. Studies of different kinds of materials and micro-heterostructures composed of such materials are aimed at seeking new representatives of topological insulators and predicting their new functionalities.