

Description for the general public

A new material called silicene is the main topic of the proposal. Silicene is silicon analogue of graphene. It consists of one layer of Si atoms arranged in a 2D honeycomb lattice and as that it possesses most of the fascinating properties of graphene. Beside many similarities with graphene silicene reveals additional features which open a route to use it in future nanoelectronics.

The main goal of the project is determination of influence of adsorption of other atoms (Cr, Mn, Fe and Co) on the silicene surface on its physical properties. In particular we are going to study electronic structure and magnetism induced by the presence of new atoms on the surface.

Available results of theoretical investigations indicate the presence of new phenomena in that system which have not been experimentally observed or observed but at extremely low temperatures. Among those phenomena are quantum anomalous Hall effect and quantum valley Hall effect. According to numerical calculations adsorption of transition metal atoms on silicene would make possible to observe such effects even at room temperature.

Bringing technology of making ferromagnetic silicene and/or making ferromagnetic contacts on silicene under control would allow preparation of spintronics devices like e.g. spin transistor. In this way it would cause integration of spintronics with existing silicon technology. On the other hand, easily tuned band gap in silicene, which is one of the advantages over graphene, should make possible development of a new field of science and technology called valleytronics. It takes advantage of additional, valley degree of freedom for carrying bits of information, beside charge (classic electronics) and spin (spintronics) degrees of freedom. Based on the valley degree of freedom different electronic (valleytronic) devices have already been proposed e.g. valley filters, valley valves and sources of valley current. Now the important point is to give an experimental input and verify theoretical predictions.