A progress in miniaturizing of electronic devices meets several technological barriers and, moreover, more fundamental problems arise because of dominant quantum effects. It becomes particularly important in one-dimensional (1D) nanostructures. In series of publication we showed that in some specific circumstances, using Molecular Beam Epitaxy technology and due to self-assembly processes, metallic atoms form matrices of ordered chains on a stepped surface of a monocrystal (vicinal surface). Monoatomic chains at the surface can be regarded as ultimately small conductors for future nanometer-size electronic devices with many potential applications.

The project aims experimental and theoretical investigation of 1D topological states in atomic chains fabricated on vicinal and flat semiconducting surfaces. The goal of the project is to understand physical processes governing creation and control of non-trivial topological states is such 1D structures. Matrices of atomic chains with non-trivial topological states can be regarded as a new material with unique electrical properties. We presume, that the presence of topological states in atomic chains, and in more complex structures composed of atomic chains, will enhance their surface electrical conductivity.

In order to establish conditions necessary to create and to preserve topological state in the system extensive calculations of electronic properties of topological atomic chains on crystalline substrate will be performed. The goal of the project is to find atomic systems exhibiting spin-dependent Friedel oscillations and induced topological states. Unique equipment consisting of Scanning Tunnelling Microscope (STM) with spin-resolution capabilities and Atomic Force Microscope (AFM) operating in ultra-high vacuum (p~10^{-11}-mbar) and at liquid helium temperatures (4.2K) allow for imaging of single atom, for manipulation of atoms, and for characterization of a local electronic and spin structure.

The proposed studies are novel. To our best knowledge fabrication and investigation of 1D topological insulators on modified vicinal surfaces were not reported yet. The studies allow for comprehensive description of nontrivial states in atomic chains. The knowledge of electronic and electric properties of such atomic chains may contribute to their future application in spintronics, in quantum computers, and in nanoelements demanding ultrafast electric connections (logical gates, qubits, nanotransistors).

More on topics and realisation of the project will be present at: http://nano.umcs.lublin.pl