Abstract of PhD thesis entitled "*Electrical properties of normal and topological atomic chains on different substrates*" written by Marcin Kurzyna

Atomic chains and low-dimensional systems are of great interest nowadays. As the thinnest electric conductors, they can found many possible applications in nanoelectronics and optoelectronics. Such systems reveal many interesting effects like conductance oscillations, spin-charge separation, charge density waves and others. In this dissertation I focus on theoretical description of electrical properties of normal and topological atomic chains on different substrates, taking into account Coulomb repulsion, spin-orbit coupling, electron localization level and geometry of the substrate. In these calculations, I use tight-binding Hamiltonian with Green's functions formalism and evolution operator technique. Electrical properties of atomic chains are determined basing on the calculations of local density of states, charge occupations, conductance and currents in both stationary and non-stationary (time-dependent) cases. This doctoral dissertation is based on a set of 7 scientific papers written and published during my PhD studies.

The results presented in these papers reveal that atomic wires are barely affected by external perturbations and can play a role of an effective electron pump. Additionally, theoretical findings presented in this thesis reveal that topological boundary states in certain conditions can exist outside non-trivial topological phase of atomic chain and travel along internal sites of the structure. Furthermore, there is shown that two quantum-dot system reveals a periodical structure in time domain visible in the local density of states which is related with the stationary long atomic chains density of states (we call these structures transient crystals). Lastly, the dissertation shows computer tools which allow one to model atomic structures on a surface and examine their electrical properties in both stationary and time-dependent cases and perform highly detailed 3D plots.

21.04.22 Marcin Kurzyna