DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The current rapid progress of nanotechnology is not only due to the development of more advanced methods of designing and producing new materials with unique properties, but is also connected with the development of new experimental techniques that allow for more comprehensive characterization of materials. An excellent example of a new experimental technique that raises broad interest among scientists in many fields such as physics, chemistry, biology, material engineering is Tip Enhanced Raman Spectroscopy – TERS. It is based on the enhancement effect of inelastic light scattering (Raman scattering) using a scanning probe tip of the STM or AFM microscopes. The process of enhancement of Raman scattering is a result of laser light induction of the plasmons oscillation on the scanning probe tip, which leads to very strong local electromagnetic field enhancement at the points above which the scanning probe tip is located. As a result, the irradiated scanning probe of the microscope increases the cross–section of Raman scattering by several orders of magnitude, enabling the detection of vibrational modes of even a single molecule.

The scientific goal of the project is to design, build and test a TERS–STM spectrometer based on the Scanning Tunneling Microscope (STM) possessed by our group, working in ultra–high vacuum (UHV) and then to conduct a number of molecular–resolution studies of chiral organic molecules adsorbed on plasmonic substrates. In the project, with TERS–STM technique, we will study various helicene derivatives because of their numerous desirable physical and chemical properties, among which the most important for our project include is large circular dichroism which is defined as the difference in absorption of right- and left-handed circularly polarised light. At the beginning of project experimental results of vibrational modes of individual molecules will be compared with theoretical calculations enabling the chemical identification of individual molecules adsorbed on the surface.

Noteworthy is the fact that in the final stage of the project implementation, an attempt will be made to identify molecular chirality at the level of a single molecule based on the enhanced signal of Raman scattering. We believe this will be possible thanks to the use of circularly polarized light that will be used to irradiate the molecular sample and the tip. The main hypothesis of the proposed research project is that analysis the degree of circular polarization of inelastic scattered light enhanced by STM tip should provide information related to molecular chirality at single molecule scale. At the end of the project, TERS spectral information related to molecular chirality will be verified and correlated with the conventional STM topographic image. We do believe that the project is a chance to develop a whole new innovative experimental technique that enables the identification of molecular chirality at the level of a single molecule.