Polymer nanotweezers as a multitool for understanding interactions at the nanoscale

Polymers and nanomaterials are perhaps the two most influential classes of materials discovered in the past century. It is easy to notice how the former material has revolutionized life as we know it. For example, most of the appliances that we use every day are made of polymers. Besides, regardless of the part of the world, mankind uses polymers in numerous applications. Nanomaterials discovered and popularized at the turn of the XX and XXI centuries have a similar, if not higher, application potential. However, their utilization is challenging as it requires structure control at the atomic level.

One of the most promising kind of nanomaterials is carbon nanotubes (CNTs), which are a cylindrical form of carbon with diameters 10 000 times smaller than that of human hair. Their remarkable electrical conductivity and versatile optical properties make them auspicious for utilization in various parts of technology. However, the structure of these tiny tubules is hard to tackle, and thus, the synthesized material commonly contains more than 20 different types of CNTs. Therefore, to study the nature of this material, these mixtures need to be somehow separated into distinct fractions. It was recently discovered that the key to sort the CNTs in organic media can be nothing else than the polymers mentioned above, thereby picking CNTs like tweezers.

In this project, a broad selection of conjugated polymers and co-polymers will be synthesized and employed to understand the mechanism of the extraction process, which is possible thanks to them. A thorough experimental investigation supported by modeling will reveal how and why particular polymers can be used to harvest CNTs of a defined structure. Furthermore, the isolation of these species will be invaluable for studying how changing the order of carbon atoms at the nanoscale influences the characteristics of CNTs. Consequently, the project will be beneficial to many branches of modern materials science and bring the CNTs much closer to their long-anticipated applications.