VABILO NA PREDAVANJE V OKVIRU DOKTORSKEGA ŠTUDIJA KEMIJSKE ZNANOSTI / INVITATION TO THE LECTURE WITHIN DOCTORAL PROGRAMME IN CHEMICAL SCIENCES

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z naslovom / title:

Single-Molecule Chemistry: Integrating and Characterizing Molecular Electronics

v sredo, 6. 11. 2024 ob 15. uri
v predavalnici 1 v 1. nadstropju Fakultete za kemijo in kemijsko tehnologijo, Večna pot 113 **/**
on Wednesday, 6. 11. 2024 at 15.00
in lecture room 1, 1st floor at the Faculty of Chemistry and Chemical Technology, Večna pot 113

Vljudno vabljeni! / Kindly invited!

FKKT

Abstract:

In recent years incredible strides have been made in the development of molecular electronic systems that possess unique functionality. By combining chemical design with physical modeling and electrical characterization techniques it has become clear that molecules are capable of a wide range of impressive electronic functions that extend far beyond the development of standard devices such as transistors and diodes. An array of electromechanical, electrochemical, thermoelectric, and quantum devices now provide promise for memory devices, sensors, and multi-state logic units which could yield new paradigms for in-memory computing, various post von Neumann architectures, or for chemical and biological sensing systems. But, despite these possibilities, two major issues that arose in the nascent days of molecular electronics still linger and limit the ultimate utility of these devices. These issues are integration and robust external characterization.

Despite a wide range of unique devices, and novel chemical and physical properties, it has remained difficult to integrate these materials into a larger-scale system in a way that is reliable, reproducible, and eventually manufacturable. This difficulty arises because the contacts to these nanoscale devices must be precisely fabricated with angstrom-level resolution to make reliable connections, and this cannot be achieved at-scale with even the highest-resolution lithography. Here we introduce an approach that circumvents this issue by precisely creating nanometer-scale gaps between metallic carbon nanotubes (CNTs) that serve as the electrodes. We use a self-aligning, solution-phase process to create the gaps, and the resulting structures allow facile integration with conventional micro-electrode arrays fabricated using standard photolithography with high-yields. The CNT separation is controlled by covalently binding individual molecules to two CNTs in solution phase so that the gap is precisely matched to the molecular length. These junctions are then integrated with top-down lithographic techniques to create single-molecule circuits that have electronic properties dominated by the molecule in the junction, have reproducible conductance values with low dispersion, and are stable and robust enough to be utilized as active, high-specificity electronic devices. In addition, we will discuss the characterization of molecular electronic devices. Again, the size of the molecules relative to the electrodes makes conventional molecular characterization techniques extremely difficult to implement, and as such details about the system must often be inferred from their electrical characteristics. Here we discuss the development and utility of combined opto-electronic characterization to extract additional details about molecular devices and their structure and function.