Aptamers – new aspects of their use in electronic sensing

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DNA-based aptamers have become interesting bioreceptors in diagnostic platforms, with excellent selectivity for their target molecules, able to ensure sensitive and specific analysis in biological fluids such as blood, serum, saliva, sweat, or urine. Very attractive was the observation that aptamers can be raised by SELEX also against small analytes, a notorious challenge for other receptor systems and sensor formats. On the other hand, a general concern were the negative charges of the sugar- phosphate backbone of DNA- aptamers that might impact their performance as receptors for biosensing applications in clinical settings as their binding properties might depend on details of the ionic milieu, e.g., the pH and the ionic strength, of the analyte solution.
Hence, the question came up whether significant benefits for the operation of aptamer-based sensors in analyte cocktails of varying ionic properties might come from the use of DNA mimics such as peptide nucleic acids (PNAs) as aptamer receptor systems. But what would happen to the sensing mechanism in electronic sensing, where the potential reorganization of the aptamer upon binding its ligand is believed to lead to a strongly enhanced reorganization of the interfacial charge distribution resulting in the sensitive detection of bio-affinity reactions in these types of sensors.
These questions will be addressed in this talk, and new perspectives offered by PNA-bioreceptors coupled to graphene-based field effect transistors (gFETs) as transducers will be discussed with specific emphasis on the sensing of thrombin and of cardiac troponin I (cTnI, cf. Fig. 1) as clinically relevant analytes.

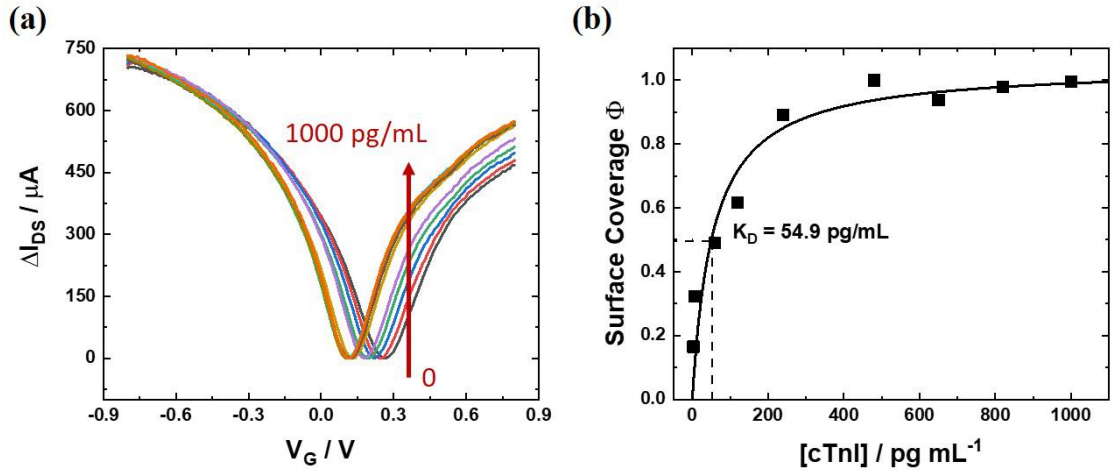

Figure 1: An example for the electronic detection of cTnI in buffer solutions, varying in concentration from 0 to 1000 pg/mL. (a) Series of $I_{DS}V_G$ curves at different cTnI concentrations; (b) Langmuir isotherm analysis of the data from (a).