Stimuli-Responsive DNA-Based Materials

Itamar Willner

Institute of Chemistry, The Hebrew University of Jerusalem, Jerusalem 91904, Israel

The information encoded in the base sequence of nucleic acids (DNAs) introduces structural and functional properties into the biopolymer. These include recognition (aptamer) and catalytic (DNAzyme) functions and signal-triggered properties to undergo structural switchable reconfiguration. Two topics will be addressed in the presentation:

(i) A new concept to develop catalytic nucleic acids (nucleoapzymes) by the conjugation of DNAzymes or transition metal complexes to aptamers will be addressed.

(ii) Different stimuli-responsive DNA-based materials and their applications will be discussed. These will include stimuli-responsive DNA-capped SiO_2 nanoparticles, DNA-based microcapsules, DNA-based metal organic frameworks (MoFs) and DNA-based hydrogels will be introduced. The use of the stimuli-responsive materials as targeted drug carriers and as switchable catalysts will be discussed.

Furthermore, a versatile method that implements the hybridization chain reaction for the assembly of stimuli-responsive nucleic acid-acrylamide hydrogels on surfaces, and nucleic acid-acrylamide microcapsules, will be introduced.

Finally, the implementation of stimuli-responsive DNA hydrogels as shape-memory matrices and as hybrid hydrogels undergoing programmed reversible structural transitions will be highlighted.