|  |  |  |
| --- | --- | --- |
|  |  | הטכניון - מכון טכנולוגי לישראל  TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY |
| הפקולטה להנדסה כימית  ע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Wednesday, December 23rd, 2020 at 13:30**

**Department Colloquium**

<https://technion.zoom.us/j/97591164072>

**From Biological Self-Assembly to Metabolite Nanotechnology: Simplicity is the Ultimate Sophistication**

**Prof. Ehud Gazit**  
Department of Molecular Microbiology and Biotechnology, Department of Materials Science and Engineering, Tel Aviv University, Tel Aviv, Israel

Bio-inspired nanotechnology is a key front in the field of molecular self-assembly of new structures and composite families at the nano-scale. Concept and notions from biological self-assembly could allow the design and fabrication of nanomaterials, while molecular self-assembly paradigm could be applied to biological systems. Our work on the mechanism of aromatic peptide self-assembly, lead to the discovery that the diphenylalanine recognition motif self-assembles into peptide nanotubes with a remarkable persistence length. Other aromatic homodipeptides (including those with non-coded amino acids as DOPA) could self-assemble in nano-spheres, nano-plates, nano-fibrils and hydrogels with nano-scale order. The modification of peptide building blocks with the Fmoc protecting group allows the formation of hydrogels with nano-scale order. We demonstrated that the peptide nanostructures have unique chemical, physical and mechanical properties including ultra-rigidity as aramides, semi-conductive, piezoelectric and non-linear optic properties. We also demonstrated the ability to use these peptide nanostructures as casting mould for the fabrication of metallic nano-wires and coaxial nano-cables. The application of the nanostructures was demonstrated in various fields including electrochemical biosensors, tissue engineering, and molecular imaging. We had developed ways for depositing of the peptide nanostructures and their organization. We had use inkjet technology as well as vapour deposition methods to coat surface and from the peptide “nano-forests”. We recently demonstrated that even a single phenylalanine amino-acid can form well-ordered fibrilar assemblies of distinct electron diffraction pattern and toxic properties. The combination of DNA properties and peptide backbone in the form of Peptide Nucleic Acid (PNA) resulted in light emitting assemblies that exhibit both stacking and Watson-Crick base-pairing. We recently extended our studied to single amino acids and metabolites. We established the concept that even these entities can form well-ordered assemblies with unique physical properties.

Selected References:  
1. Reches, M. and Gazit, E. (2003) Casting Metal Nanowires within Discrete Self-Assembled Peptide

Nanotubes. *Science* **300**, 625-627.

2. Reches, M. and Gazit, E. (2006) Controlled Patterning of Aligned Self-Assembled Peptide Nanotubes. *Nature Nanotech.* **1**, 195-200.

3. Adler-Abramovich L., Aronov D., Beker P., Yevnin M., Stempler S., Buzhansky L., Rosenman G. and Gazit E. (2009) Self-Assembled Arrays of Peptide Nanotubes by Vapour Deposition. *Nature Nanotech.* **4**, 849-854.

4. Adler-Abramovich, L., Vaks, L., Carny, O., Trudler, D., Frenkel, D., & Gazit, E. (2012) Phenylalanine Assembly into Toxic Fibrils Suggests Amyloid Etiology in Phenylketonuria. *Nature Chem. Biol.* **8**, 701-706.

5. Levin, A. Mason, T. O., Adler-Abramovich, L., Buell, A. K., Meisl, G., Galvagnion, C., Bram, Y., Dobson, C. M., Knowles, T. P. J., & Gazit, E. (2014) Ostwald’s Rule of Stages Governs Structural Transitions and Morphological Control of a Dipeptide Supramolecular Polymer. *Nature Commun.* **5**:5219.

6. Berger, O., Adler-Abramovich, L., Levy-Sakin, M., Grunwald, A., Liebes-Peer, Y., Bachar, M., Buzhansky, L., Mossou, E., Forsyth, V. T., Schwartz, T., Ebenstein, Y., Frolow, F., Shimon, L. J.W., Patolsky, F. and Gazit E. (2015) Light Emitting Self-Assembled Peptide Nucleic Acids Exhibit Both Stacking and Watson-Crick Base-Pairing*. Nature Nanotech.* **10**, 353-360.

7. Mondal, S., Adler-Abramovich, L., Lipman, S., and Gazit E. (2015) Formation of Functional Super-Helical Assemblies by Constrained Single Heptad Repeat. *Nature Commun*. 6:8615.

8. Levin, A., Michaels, T. C. T., Adler-Abramovich, L., Mason, T. O., Mueller, T., Mahadevan, L., Gazit, E., & Knowles, T. P. J. (2016) Elastic Instability-Mediated Actuation by a Supramolecular Polymer. *Nature Physics* **12**, 926-930.

9. Arnon , Z., Vitalis , A., Levin, A., Michaels, T., Caflisch, A., Knowles, T.P.J., Adler-Abramovich, L. & Gazit, E. (2016) Dynamic Microfluidic Control of Supramolecular Peptide Self-Assembly. *Nature Commun.* **7**:13190.

10. Mondal, S., Varenik, N., Bloch, D.N., Atsmon-Raz, Y., Adler-Abramovich, L., Shimon, L. J. W., Miller, Y., Regev, O., & Gazit, E. (2017) A Minimal Length Rigid Helical Peptide Motif Allows Rational Design of Modular Surfactants. *Nature Commun.* **8**:14018.

11. Bera, S., Mondal, S., Xue, B., Shimon, L. J. W., Cao, Y., & Gazit, E.\* (2019) Rigid Helical-like Assemblies from a Self-Aggregating Tripeptide. *Nature Mater.* **18**, 503–509.

12. Makam, P., Yamijala, S. S. R. K. C., Tao, K., Shimon, L. J. W., Eisenberg, D. S., Sawaya, M. R., Wong, B. M., & Gazit, E.\* (2019) Nonproteinaceous Hydrolase Comprised of Phenylalanine Metallosupramolecular Amyloid-Like Structure. *Nature Catal.* **2**, 977–985. (Featured in a "News and Views" article at: *Nature Catal.* **2**, 949–950)