The Bio-Organic Materials Chemistry Laboratory

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BOMCLab FORTH
Bio-Organic Materials Chemistry Laboratory

Activities: Synthesis of Organic Polymer Systems, Biohybrid Macromolecules, Polymeric Thin Films & Particles, and Materials for Biosensor Applications

The Bio-Organic Materials Chemistry Laboratory (BOMCLab) is a joint activity between the IESL and IMBB institutes of FORTH to provide the research infrastructure for the synthesis and characterization of organic polymers, bio-polymer- and polymer-inorganic hybrids, polymer thin films, polymeric colloid particles, and biosensor matrix materials. These materials form the basis for the development of novel polymer-based devices and the resource for tailor-made polymer derivatives for the broad requirements of the FORTH-IMBB/IESL setting, as well as for national and international collaborations.

Organic polymer systems span a wide range of functionalities and architectures and exhibit a vast range of attractive properties in bulk, in solution and at surfaces. Control over the polymer structure and thus the relationship between structure, properties, and applications is achieved by the use of "living" or controlled polymerization techniques. By these methods stimuli-responsive polymers and hybrid nanostructured materials are prepared, which self-assemble to form complex hierarchical structures in solution or at surfaces.[1]

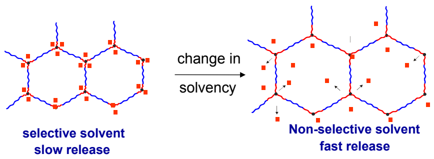

Figure 1*: Schematics of a sovency-dependent release mechanism in a responsive polymer network.*

Biohybrid macromolecules are formed by conjugation of biomolecules with synthetic polymers to combine the properties of both components.

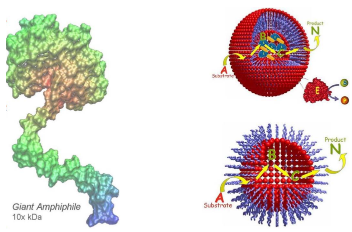

Figure 2*: Polymer-peptide hybrid (left) and vesicular assembly structures (right).*

Using different chemical philosophies ("grafting to" and "grafting from") and a combination of chemical, biochemical, and polymer synthetic approaches, such macromolecular chimeras can be synthesized with high precision and self-assemble into functional nanoarchitectures with dimensions from 20 nm up to several µm.[2]

Polymeric thin films & particles with dimensions from several nm to many µm find a vast number of technical applications due to the combination of the specific polymer properties with the unique particle and film architectures. Full control over chemical composition, polydispersity, film thickness or particle dimension, and functional groups with selected polarity, reactivity, or charges is provided by the synthesis. The particles can be further used to build hierarchical superstructures by mixed colloid crystallization and inverse opal formation.[3]

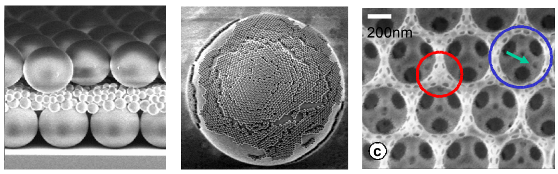

Figure 3*: Hierarchical colloid assembly structures.*

Biosensor platforms integrate such advanced polymer materials as active matrices with a broad range of functionalities that can be tailored in great detail by synthetic protocols and preparation methods.

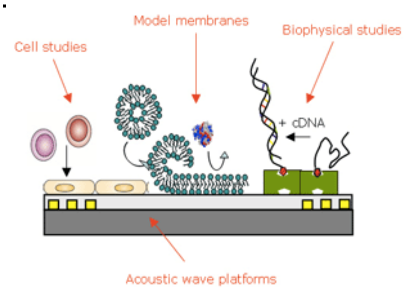

Figure 4*: Biosensor platform for various analyte systems.*

References

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[2] B. Le Droumaguet, K. Velonia, *Angew. Chem. Int. Ed.* **2008**, *47*, 6263-6266; B. Le Droumaguet, K. Velonia, *Macromolecular Rapid Communications* **2008**, *29*, 1073-1089.

[3] J. Wang, Q. Li, W. Knoll, U. Jonas, *J. Am. Chem. Soc.* **2006**, *128 (49)*, 15606-15607; and M. Retsch, Z. Zhou, S. Rivera, U. Jonas, M. Kappl, X. S. Zhao, Q. Li, *Macromol. Chem. Phys.* **2009**, *210 (3-4)*, 230-241.