DYNAMIC AND RESPONSIVE LANGMUIR-BLODGETT FILMS

Putting together all the pieces constituting a LEGO set and shaking vigorously will *not* produce a build presented on the box. Connecting one brick after another is laborious and requires external devices or operator, which suffice the definition of "top-down" approach of materials synthesis. In "bottom up" approach it is possible to stipulate the proper rules, which favors contact of specific "bricks" resulting in spontaneous formation of resulting structure. However, only an outline of the guidelines governing the process of spontaneous formation of complex nanostructures (self-assembly) is known. Designing new molecules and nanoparticles with a defined structure still does not guarantee obtaining material with specific and desired properties.

Self-assembly is a unifying concept in nature. The origin of many systems, both living and unanimated, that exhibit characteristic length scales larger than the ones of their individual components, can be re-conducted to self-assembly. It leads to the formation of hierarchically complex structures with spatial correlations across multiple length-scales. There are at least two aspects of self-assembly that are inspiring: first, all forms of life are self-assembled systems and so, understanding self-assembly processes could give us better understanding of life itself. Second, the apparent ease with which self-assembly can construct complex structures from simple components spurs imagination for the futuristic modes of "autonomous" fabrication or manufacturing. Because self-assembly is a parallel process, and because it does not involve any devices to impose order on nanostructures, it will, when applicable, ultimately always have an economic advantage over other methods of fabrications.

Within the proposed OPUS project we will study the dynamic effect of external stimuli on thin films. We will utilize light, magnetic field and electric field to pump energy into the system to push it away from the equilibrium state. We will create novel materials and responsive systems. This will not only expand the knowledge, but will also have potential for application.

Langmuir and Langmuir–Blodgett techniques combine both of the essential bottom-up assembly approaches, namely, self-assembly and directed-assembly and thus could be regarded as ideal methods for the preparation of well-ordered nanomaterials characterized by the required structure and desired properties. Langmuir and Langmuir-Blodgett method will be utilized to obtain new materials of advantageous parameters and novel responsive 2D systems from simpler entities – especially nano-objects. Assembly at the air–water interface and subsequent transfer of films onto a solid substrate assure very good control over the process and quality of the film. Dynamic changes within Langmuir films directly at the air/water interface are usually imposed only due to the mechanical compression. Adding new layer of complexity to the system might open completely new applications for this well-established methods.