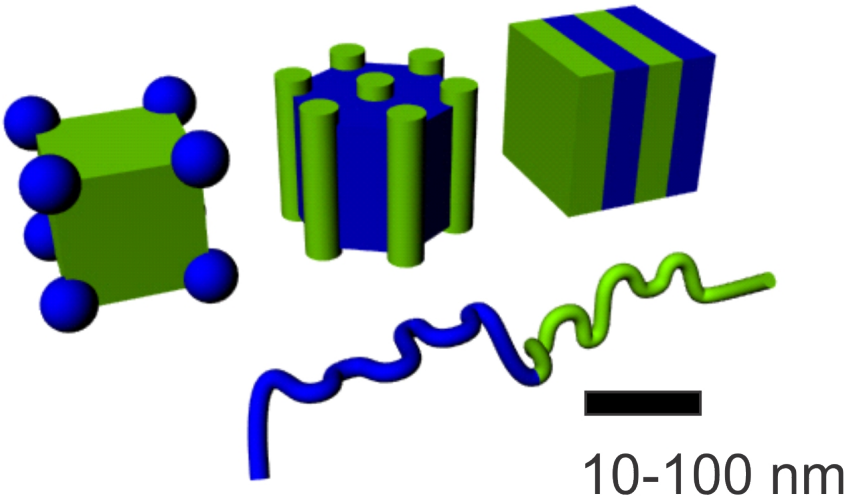
Reg. No: 2015/19/P/ST5/03813; Principal Investigator: dr Paweł Wawrzniec Majewski

Self-assembly is the essence of the *bottom-up* paradigm of nanotechnology. In opposition to conventional manufacturing methods, where the desired level of miniaturization is primarily achieved by laborious repetition of material-removal steps, self-assembled materials literally *build themselves* starting from the molecular level with little or no external help. Block copolymers (BCPs) are very powerful self-assembling motif composed of permanently-joined chains of different chemical composition which makes them mutually immiscible and induces the process of microphase separation. The separation at the level of typical chain-size (10-100 nm) leads to the formation of highly regular, ordered patterns (depicted below), which lie in the focus of interest of the nanomaterials researchers due to the convenience of preparation (solution-based methods) and the broad range of potential applications. These include: water purification and battery membranes, organic photovoltaics, surface patterning (alternative to conventional lithography), and templated synthesis of various nanomaterials. While BCPs typically serve as immobile architectural elements, providing convenient mechanical platform for nanodevices, another class of self-assembled soft-materials – liquid crystals (LCs), widely known for their use in liquid crystal displays (LCD), serve as labile and highly responsive building blocks. Our research towards novel smart materials takes advantage of the complementary properties of the LCs and BCPs. In our hybrid, BCP-LC composites, the BCP supports and directs the orientation of the LC part, which in turn, renders the hybrid with a desired functionality e.g., ability to recognize and transport particular types of molecules, mechanically respond to the presence of the light, electric or magnetic field. This approach opens a synthetic perspective for a novel type of soft materials which are robust yet flexible and can find application as wearable sensors, smart fabrics or paintable membranes.



Block copolymer structures.