Abstract

**Ordered thin films of amphiphilic compounds and nanoparticles**

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Results of three research projects are presented in the thesis. The separated parts are linked by the main idea of utilization of the Langmuir-Blodgett technique to study the intriguing behavior of matter in 2D systems as well as the possible applications of the scientific findings. In the first part of the thesis, properties of thin films of a new class of liquid crystalline amphiphilic compounds, namely bolaamphiphiles, are presented. A study of the influence of fluorination on the film stability revealed unusual reversibility and reproducibility of the $\pi(A)$ isotherms of films of partially fluorinated bolaamphiphiles. Monolayers of these compounds did not collapse during compression on the air/water interface and ordered lamellar structures were formed instead. The balance between rigidity and flexibility of the molecules, adjusted by partial fluorination and the shape of the molecules, was the key factor to avoid irreversible aggregation of the molecules and to create ordered multilayer structures. Further work revealed that no compression was needed to form ordered 3-layer films of bolaamphiphiles. Simple drop casting experiments gave qualitatively identical results comparing to those based on the Langmuir-Blodgett method. The self-assembly of bolaamphiphiles induced ordering in thin films containing other species.

The results presented in second part of the thesis originated from the above mentioned studies on mixtures of liquid crystalline compounds and nanoparticles. Thus prepared surfaces were afterwards used as substrates in the chemical vapor deposition process of gallium nitride nanowires growth. On that scaffolding gold microflowers were deposited from solution. The obtained morphology of the final material could be controlled at each step of the preparation process to tailor its properties for desired purposes. The obtained surface was found to be active in surface enhanced Raman spectroscopy (SERS) with the enhancement factor around $10^7$. The label free detection of DNA was demonstrated. Prepared substrates gave reproducible SERS spectra both across a single platform and between different platforms. The average spectral correlation coefficients ($\Gamma$) was 0.87. Moreover, the obtained material proved to be very stable.

The third part of the thesis deals with the behavior of a new class of polymers – hyperbranched polymers – at the air/water interface. Because of their novel molecular design, a number of unexpected phenomena were observed. The mechanism of the collapse and its reversibility is discussed in detail. The temperature and/or surface pressure changes induced a first order phase transition in the monolayer. The overall picture of the transition resembled the solid – liquid phase transition in two dimensions.