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Editorial

Self-Assembled and Artificial Surfaces/Interfaces: From Soft Matter to Metamaterials

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Surfaces or interfaces play an essential role in achieving the performance of materials, including both the mechanical and the physical/chemical properties. The interfaces dominate the behavior of many types of materials ranging from traditional condensed matter to soft condensed matter, such as nanoparticles, thin solid films, colloids, and electrorheological fluids. The surfaces/interfaces can be obtained via various approaches, say from self-assembly to completely artificial design. The appropriate design of artificial surface structure can be utilized to manipulate the electromagnetic waves or sound waves. Despite the fact that the topic has a long history of research, it still remains a challenge to get a full understanding of the formation mechanisms and the functionalities of these interfaces, because of the coupling between surfaces/interfaces with external fields and the complexity of multiscale interactions. In this special issue, we have invited several papers that address these concerns.

Evaporation induced self-assembly and pattern formation is one of the simplest but important approaches to fabricate ordered structures. In the first paper of the topical issue, S. Tarafdar et al. have reviewed the various patterns obtained from droplet drying ranging from simple solutions to complex biological liquids. The review includes both experimental observations and theoretical and simulation results and highlights the effect of contact angle on the formation of these patterns. In the second paper, Y. Zhang et al. have reported that the increase in substrate roughness can lead to enhanced coffee-ring effect. By contrast to the self-assembly caused by direct evaporation, the so-called breath figure method has a droplet nucleation process which serves as a template for the formation of porous structures. At an appropriate condition, hierarchical porous structures can be obtained, as reported in the third paper by Z. Li et al.

The self-assembly on surfaces/interfaces is of great importance to fabricate two-dimensional functional materials, where the spreading of building block solution on the interfaces plays a central role. In the fourth paper, M. Li et al. have presented a study on diffusion behavior of an ink droplet on silk woven fabrics and found that the woven structure can lead to anisotropic diffusion dynamics of ink. In the fifth paper, F. Chen et al. have found that the aggregation behaviors of copolymers at the air-water interface are dependent on the block ratios. The different aggregation processes lead to varied interfacial rheological properties and Langmuir-Blodgett (LB) film morphologies.

Artificial surfaces/interfaces provide an alternative approach to achieve unique functionalities, e.g., metamaterials. With proper arrangement of these surfaces/interfaces, acoustic waves or electromagnetic waves can be manipulated as required. In the sixth paper, X.-L. Yan et al. have obtained a precisely controllable unit structure with negative effective modulus by shifting the sizes of the unit cell. In the seventh paper, using a sessile drop method, L. Zhang et al. have investigated the effect of direct current (DC) on the wetting

behavior of Cu substrate by Ga–25In–13Sn liquid alloy at room temperature. In the eighth paper, H. Chen has proposed and numerically investigated an acoustic metasurface made of a composite structure of cavity and membrane, which can steer the reflected waves at will. In the ninth paper, W. Zhao et al. have investigated surface modification of polyimide (PI) film through TiO_2 photocatalytic treatment, which shows that the photocatalytic treatment is an environmentally friendly and effective method for the surface modification of PI films.

We hope this collection of articles will be useful to the condensed matter/material science community and inspire further research in new directions.

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