2D Nanostructures from Block Copolymer Coated Nanoparticles

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Defined nanostructures formed from nanoparticles in polymer matrices are essential for next-generation functional materials used in e.g. electrical and energy conversion devices. The greatest challenge is the precise control of the nanoparticle position and ordering within the polymer matrix which is crucial for the performance in nanotechnology applications. One of the best ways to achieve ordered 2D- and 3D-spatial nanostructures is the use of block copolymers and the integration of nanoparticles selectively into one of the domains or into the domain interface. Yet, the unfavourable nanoparticle/polymer enthalpic interaction and the loss of conformational entropy of the polymer chains close to the nanoparticle surface make a controlled and stable integration of inorganic nanoparticles into polymer matrices difficult.

Our idea to overcome these problems was to coat nanoparticles directly with block copolymers. We were able to demonstrate that the self assembly of such block copolymer coated nanoparticles leads to ordered structures with microdomains containing ordered nanoparticle arrays. (see Fig. 1) The resulting highly loaded nanocomposites allow for a precise control of the inter-particle distance. By varying the grafting density of the block copolymer on the nanoparticle surface the inter-particle distance can be tuned from direct nanoparticle surface contact to separation of several nanometers, thus creating different nanostructures. This versatile method is widely applicable for a great variety of nanoparticles and thus suitable for a broad range of applications. [1]

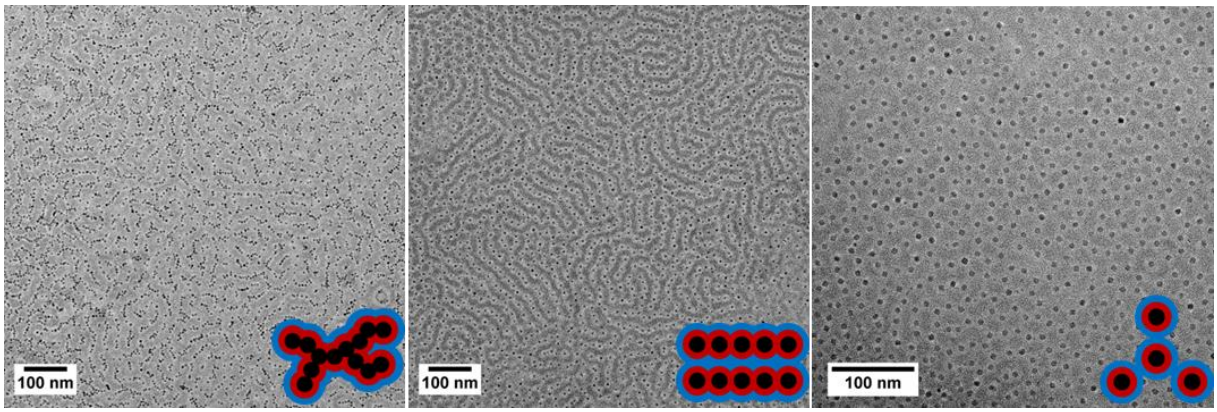

Figure 1. TEM images of different types of nanoparticle arrays which can be realized by variation of the grafting density of the block copolymers.

[1] V. B. Leffler, L. Mayr, P. Paciok, H. Du, R. E. Dunin-Borkowski, M. Dulle, S. Förster, *Angew. Chem. Int. Ed.* (2019), in press.

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