Functional patchy microcolloids for electrostatically directed self-assembly

Fatemeh Naderi Mehr[1, 2], Dmitry Grigoriev[1], Nikolay Puretskiy[1] and Alexander Böker[1, 2]

[1] *Fraunhofer institute for Applied Polymer Research IAP, Golm, Germany*
[2] *University of Potsdam, Potsdam, Germany*

A directional interaction between microcolloids can be realized through pre-defined sites on their surface, "patches", which let them follow each other in a controlled way and assemble into desired structures of higher complexity [1, 2]. In this work, we put our main effort on preparation of zwitterionic mono- and bi-patchy melamine formaldehyde (MF) microparticles with negatively and positively charged patches made of poly (methyl vinyl ether-alt-maleic acid) (PMVEMA) and polyethyleneimine (PEI), respectively (Fig. 1). Microcontact printing (µCP) was utilized to depose the polyelectrolyte inks onto the surface of the particles. The effect of concentration and molecular weight M_w of the polymeric inks on the yield and thickness of resulting patches was studied. Furthermore, the self-aggregation of patchy particles in ethanol-water (90:10) was investigated, which showed that electrostatic interactions can result in spontaneous formation of doublets of mono-patchy particles for both types of patches made of PMVEMA or PEI as well as a variety of chain-like structures of bi-patchy particles. Since the surface charges of patches and particles can be varied at different pH, the electrostatic interactions between patchy particles can also be controlled or even screened by change of pH value as well as increase of the ionic strength of the dispersion medium [3].

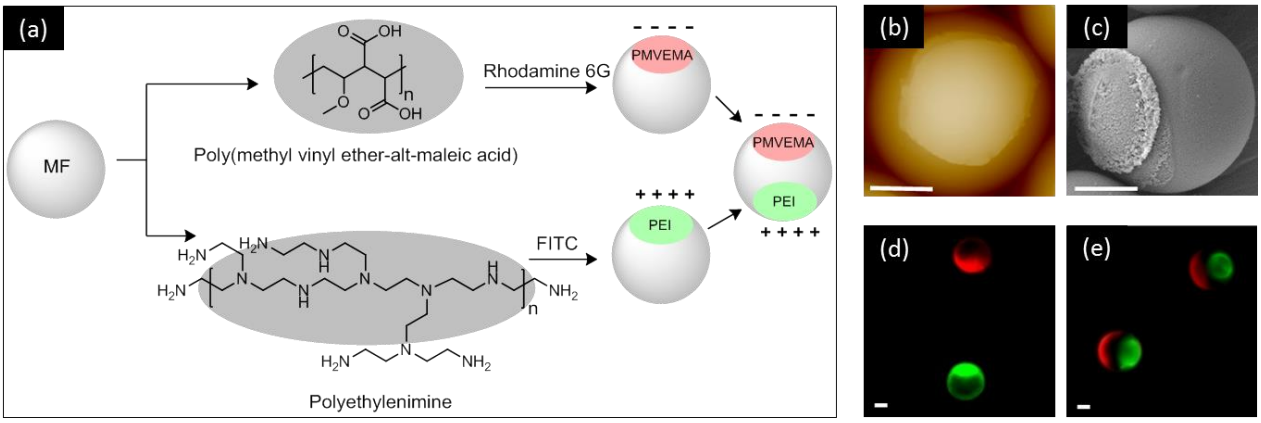

Figure 1. Scheme of generation of oppositely charged mono- and bi-patches on the surface of the MF particles (a), AFM image of a PMVEMA mono-patch (b), SEM image of a PEI mono-patch (c) and fluorescence microscope images of PMVEMA and PEI mono-patches (d) as well as bi-patches (e), which are labelled with Rhodamine 6G (red) and FITC (green), respectively (Scale bars: 2 µm).

[1] F. Naderi Mehr et al., *Soft Matter*, **15** (2019), 2430.
[2] E. Duguet et. al. *Comptes Rendus Chimie,* **19** (2016), 173.
[3] F Naderi Mehr et al., *257th ACS Meeting Proceedings* (2019).

Acknowledgement: The authors acknowledge funding from the European Research Council ERC, Grant Number 648365-REPLICOLL-ERC-2014-CoG.