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Hydrophobic, Self-Replenishing Coatings for Polar Substrates

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Maleic anhydride-containing copolymers were used as a basis to prepare functional coatings systems having good adhesion to polar substrates such as wood or cotton, while at the same time providing a hydrophobic coating surface. Pendant poly(dimethyl siloxane) (PDMS) chains were introduced along the backbone of poly(styrene-alt-maleic anhydride) (PSMA) and other maleic anhydride-containing polymers, using imide chemistry. Subsequently, surfactant-free latexes were prepared by dispersing these PDMS-modified PSMA copolymers in water.

The latexes were applied onto cotton fabric and residual anhydride functionalities were used for cross-linking reactions as well as to provide adhesion to the polar substrate. The latexes as well as the resulting cured coatings were extensively characterized using FT-IR, NMR, zeta- potential measurements, AFM, TEM, XPS and contact angle measurements. In addition, a new technique was developed to study the self-replenishing behavior of these systems as a function of time.

Static contact angles up to 141° were measured for the coated cotton, depending on, a.o., the PDMS loading and the application temperature. It was shown that the PDMS chains migrate to the air/coating interface, resulting in a phase separated morphology and a PDMS-enriched, hydrophobic coating surface. In addition, we demonstrated that self-replenishing of these systems can occur within 3–10 minutes, depending on the composition. Cross-linking of the copolymer chains afforded highly durable coatings.

These copolymer resins and the derived surfactant-free, water-borne latexes display promising properties, which can be tuned easily by changing the composition of the polymers.

[1] I.D. Gunbas, M.E.L. Wouters, R.A.T.M. van Benthem, C.E. Koning, B.A.J. Noordover J. Appl. Polym. Sci. 2012, 125, 1745.