TR0700116

UV-Curing of Nanoparticle Reinforced Acrylates

F. Bauer[1], R. Flyunt[1], K. Czihal[1], H. Ernst[2], M. R. Buchmeiser[1,3]

[1] Leibniz-Institut für Oberflächenmodifizierung, Leipzig, D-04318, Germany
[2] University of Leipzig, Department of Exp. Physics I, Leipzig, D-04103, Germany
[3] University of Leipzig, Institute of Technical Chemistry, Leipzig, D-04103, Germany

E-mail address of main author: frank.bauer@iom-leipzig.de

Polymer reinforcement by silica and alumina nanoparticles evidently yields improved surface hardness. Single mixing of nanoparticles into an acrylate formulations, however, leads to highly viscous solutions inappropriate for coating procedures. The incompatibility of inorganic fillers and organic polymers can be avoided by surface modification providing an interface between the two dissimilar materials. For example, vinyltrimethoxysilane (VTMO) can react via hydrolysis/condensation reactions with hydroxyl groups present on the inorganic surface and should bond via the polymerisation-active vinyl group to an acrylate resin through crosslinking reactions.

Grafting reactions of surface OH groups and different trialkoxysilanes were studied by thermogravimetry, infrared, and multinuclear NMR spectroscopy [1]. The copolymeri-zation of modified nanoparticles with the acrylate matrix has been investigated by ^{13}C NMR spectroscopy (Fig. 1). UV curing under nitrogen inertization revealed a lower reactivity of vinyl groups of VTMO-modified silica compared to grafted methacryloxypropyl-trimethoxysilane (MEMO) which showed complete conversion of olefinic carbons (signals at 120 - 140 ppm). Under conditions of oxygen inhibition, the effect of the kind and the concentration of photoinitiator on the photopoly-meri-zation reaction was studied. Compared to neat polyacrylate coatings the nanocomposite materials exhibit markedly improved properties, e.g., heat, scratch, and abrasion resistance. However, a much better abrasion resistance was obtained for coatings containing both silica nano-particles and corundum microparticles [2]. In particular cases, radiation curing with 172 nm photons generated by Xe excimer was performed to obtain structured polymer surfaces, i.e., matting of the reinforced acrylate coatings.

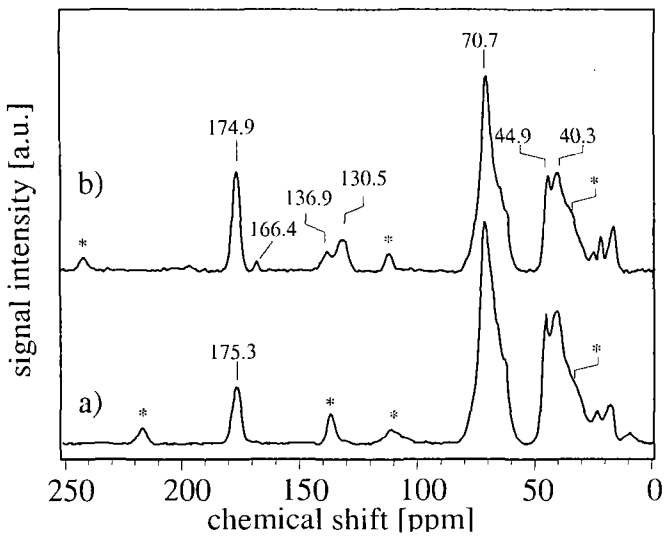

Fig. 1: ^{13}C CP MAS NMR spectra of polyacrylate nanocomposites containing 35 wt.-% silica nanoparticles modified by MEMO (a) and VTMO (b). (Asterisks denote spinning side-bands).

[1] F. Bauer, H. Ernst, U. Decker, M. Findeisen, H.-J. Gläsel, H. Langguth, E. Hartmann, R. Mehnert, C. Peuker, Macromol. Chem. Phys. 201 (2000) 2654.
[2] F. Bauer, R. Flyunt, K. Czihal, M.R. Buchmeiser, H. Langguth, R. Mehnert Macromol.Mater. Eng. 291 (2006) 493.