A New Generation of Polymer / Clay Hybrid Discs

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Polymer Layered Silicate Nanocomposites (PLSN) represent a new class of materials, which have attracted much attention because of their excellent physical properties such as high dimensional stability, gas barrier performance, flame retardancy[1] and mechanical strength when compared to the pure polymer. The first generation of nanocomposites was achieved through simple physical mixing of clay and polymer in melt[2]. In second generation PLSNs the polymer chains are attached on the basal planes through electrostatic interaction between the clay internal negative layer charge and a positive charge on a functional group of the initiator molecule. However, the dimension of the small molecules used as initiators is a disadvantage. Carrying positive charges they are able to intercalate between the layer stacks and widen them. Furthermore polymer chains having only a single positive charges on the end are prone to detach from the clay surface under stress[3,4].

To solve this problem, we developed and characterized a functional polymeric initiator, from a statistical copolymer of DMAEMA (2-(dimethylamino)-ethylmethacrylate) and BIEM (2-(2-bromoisobutyryloxy)-ethylmethacrylate). By tuning the pH one can control the charge density of the DMAEMA parts for optimum adhesion on the clay surface. Uncharged DMAEMA functions as neutral spacer. BIEM carries a bromine leaving group for controlled ATRP. By adjusting the ratio of BIEM to DMAEMA, one can control the grafting density of the resulting polymeric chains. Here we present the synthesis and properties of a new generation of clay polymer hybrid discs utilizing the polymeric initiator for grafting from via ATRP.

References:
1 Zhu, J.; Morgan, B.; Chem. Mater., 2001, 13, 3774 – 3780
2 Liu, P.; App. Clay Sci., 2007, 38, 64 – 76
3 Oral, A.; Shahwan. T.; J. Mater. Res., 2008, 23, 3316 – 3322
4 Zhao, H.; Argoti, S.; J. Pol. Sci. A, 2004, 42, 916 - 924