POLYAMIDE 6/SILICA COMPOSITES BY HYDROLYTIC AND ANIONIC POLYMERIZATION OF LACTAM BASED SILICON MONOMERS

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Conventional routes to prepare polyamide 6 (PA6) nanocomposites use nanoscopic fillers like clay minerals or silica particles, which are dispersed in the dissolved or molten polymer.[1] A thorough break up of agglomerates cannot be achieved in some cases. Another strategy is the *in-situ* polymerization of caprolactam (CL) in presence inorganic filler particles.[2] These methods are multi-step processes because a modification of the inorganic filler is necessary in most cases. The ammonium salts used as organomodifiers can lead to adverse effects like inhomogeneities in viscosity or discoloration during processing at higher temperatures.[3] Also unknown effects of silica nanopowders on health limits their application.[4]

Therefore, the *in-situ* formation of both inorganic filler and organic polymer would be favorable. Especially the combination of the organic and the inorganic building block in one bifunctional monomer should be advantageous in terms of mixing of the resulting polymeric structures. One example of this kind of monomers is the lactam containing monomer **Si(CL)$_4$**, which allows the formation of PA6 and SiO_2 in one step.[5] The polymerization can be carried out by hydrolytically or anionically catalyzed processes. Using the hydrolytic approach catalyzed by aminocaproic acid, both polymeric structures are obtained directly. [5] The size of the silica primary particles is under 100 nm, but larger agglomerates of a few micrometers are obtained due to the processing in melt.

In the anionically catalyzed reaction, the Si–N bonds is preserved during polymerization but can be hydrolysed afterwards. Therefore, the formation of SiO_2 takes place in the preformed PA6 matrix subsequently. Thus, the agglomeration of the silica particles is inhibited, leading to smaller silica domains compared to the hydrolytic approach. The incorporation of silica particles by this strategy lead to an increased thermal stability compared to neat PA6.

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