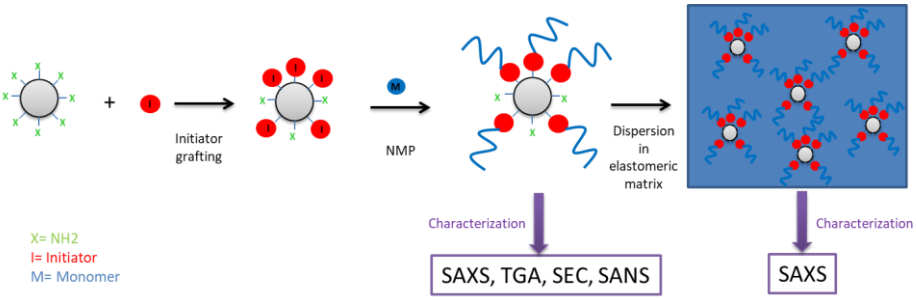
Grafted silica nanoparticle based elastomers: from synthesis to nanocomposites

Marine Bonnevide[1, 2] Trang Phan,[1] Hien The Ho,[1,4] Nicolas Malicki,[2] Marc Couty,[2] Sanat Kumar,[3] Didier Gigmes,[1] Jacques Jestin[4]

Institut de Chimie Radicalaire, CNRS UMR 7273, Université Aix Marseille - Michelin

The reinforcement of elastomer matrix with silica nanoparticles (SiO_2 NPs) has been attracting interest for many years as it may improve significantly their mechanical properties.[1, 2] As the improvement of the composite properties is related to the specific contact area between fillers and matrix, it is of high importance to control precisely the dispersion of the nanoparticles in the matrix. In the case of elastomers the interactions with silica are very weak[3] and particles tend to give undesired agglomeration phenomena. Numerous studies have been oriented to improve the dispersion of silica nanoparticles in polymer matrices. To reach this goal, one of the strategies consists in grafting polymer chains onto silica nanoparticle surface.[4] With this method the most important parameters influencing the dispersion are the grafted chain length (N) on the matrix chain length ratio (P) and the grafting density (D_g). [5]

Despite the intensive research efforts made on the grafting method and the dispersion of SiO_2 NPs in elastomeric matrices, very few studies coupling both of them have been done[6] and none of them included a complete characterization of the dispersion.



Scheme 1: Strategy followed to graft elastomeric chains onto SiO_2 NPs by NMP and disperse them into an elastomeric matrix

To feel this lack, following the strategy presented in scheme 1, we first prepared composites made from dispersion of elastomeric grafted SiO_2 NPs previously synthetized by Nitroxide-Mediated Polymerization (NMP) using an alkoxyamine as initiator. Then we characterized thoroughly the dispersion state of the NPs and the elastomeric corona through various techniques such as Small Angle X-Ray Scattering (SAXS) and Small Angle Neutron Scattering (SANS), Size Exclusion Chromatography (SEC) and Thermo-Gravimetric Analysis (TGA). In this communication we will present the synthesis of grafted SiO_2 NPs and compare the dispersion state in an elastomeric matrix depending on the ratio P/N.

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