

Improving the thermomechanical resistance of a fluoroelastomer by adding POSS nanoparticles

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Fluoroelastomers are commonly used in aeronautical industry where a thermo-chemo mechanical resistance is needed. Usually, for high temperatures applications, peroxide crosslinking combined with a coagent, is chosen. Nonetheless, even if the thermal resistance is improved, the coagent has revealed to be the main thermal weakness of this system [1]. This limitation could be overcome by adding POSS nanoparticles [2]. The way these nanoparticles act to improve the mechanical behaviour at high temperature or after thermal aging has not yet been fully understood. The main goal of this work was to understand the relationship between the structural organization of a FKM reinforced by various amounts of POSS nanoparticles and its mechanical response. In this study, the POSS used displays a functionality equal to eight as illustrated in Figure 1. This configuration provides three types of possible interactions for the nanoparticle: be inert, react with the matrix or react with itself.

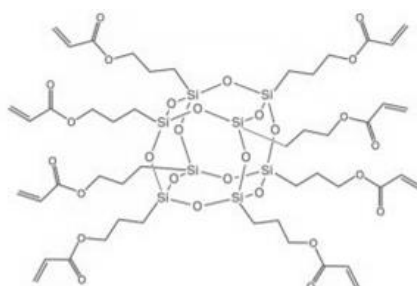


Figure 1: Structure of POSS-A with eight functional groups

After curing, thermomechanical analyses have revealed that the T_g is not impacted by different amounts of nanoparticles. Furthermore, swelling experiments combined with uniaxial tensile tests have shown that the crosslinking density is unchanged whatever the POSS content is. This indicates that these nanoparticles do not act as crosslinker for FKM. Nonetheless, the storage modulus in the rubbery plateau increases with POSS content which suggests a classical reinforcing effect of the nanoparticles. The most interesting observation regarding POSS, is its ability to react with itself to form a second network. This has been highlighted by the presence of a second relaxation in the rubbery phase observed by DMTA. $\tan \delta$ of this relaxation shifts to higher temperature with the increase of POSS.

Regarding the thermal resistance of these nanocomposites, thermogravimetric analyses have shown that increasing POSS concentration leads to the thermal degradation delay of the weak point. The link between structure and mechanical properties at high temperature and after thermal aging will enable us to understand how the POSS network could delay the thermal degradation of the weak point.

References

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