Hexagonal boron nitride as filler for elastomer nanocomposites

Federica Magaletti[1], *Gea Prioglio*[1], *Maurizio S. Galimberti*[1], *Vincenzina Barbera*[1]

[1] Politecnico di Milano, Department of Chemistry, Materials and Chemical Engineering, Via Mancinelli 7, 20131 Milano, Italy
federica.magaletti@polimi.it,

Introduction

A typical rubber compound for tyre tread is based on solution styrene butadiene rubber (S-SBR), natural rubber (NR) and precipitated silica as the main filler.
Silica is the preferred filler for tyre tread with low hysteresis because it establishes chemical bonds with the elastomer chains, and it causes a reduction of hysteresis at high temperature meaning lower dissipation of energy, lower fuel consumption and lower CO_2 emissions. Yet, processing of silica compounds is difficult, because of the pronounced supramolecular interactions. Silica based composites have high viscosity, low shelf life and require special compounding equipment [1]. The objective in this work was the partial replacement of silica with a graphite-like material such as hexagonal boron nitride (h-BN) [2].
h-BN was used both pristine and chemically modified with –OH groups.
Rubber compounds were prepared, crosslinked with a sulphur-based system and characterized to determine static and dynamic-mechanical properties.

Results

h-BN-OH was prepared by ball milling h-BN for 5 hours at 300 rpm, washing then with distilled water the powder taken from the mill. It is worth observing that h-BN-OH was not only functionalized but also partially exfoliated.
h-BN and h-BN-OH were used as fillers in partial replacement of silica, at two different levels, 15%vol and 30%vol, maintaining the same total volume fraction of the filler.
The replacement of silica with h-BN materials led to improved processability, higher dynamic rigidity and lower hysteresis and to higher stresses at low deformation with respect to the reference compound with silica as the only filler.
Unsatisfactory compatibilization and dispersion of pristine h-BN were obtained, which could easily lead to the generation of voids and tears in the rubber composite. On the other side, hBN-OH led to even dispersion and to composite material which did not reveal flaws, hence suitable to guarantee the integrity of the crosslinked composites.

References

[1] Progress in polymer science, **2002**, *27*(4), 627-687
[2] F. Magalatti, Thesis Politecnico di Milano 2021-2022