Multifunctional Properties of Rubber Nanocomposites

M.A. Lopez-Manchado[1], M. Hernández[1], L. Valentini[2], H. Aguilar-Bolados[3], R. Verdejo[1]

[1]*Instituto de Ciencia y Tecnología de Polímeros, ICTP-CSIC, Juan de la Cierva, 3 28006-Madrid, Spain*
[2]*Civil and Environmental Engineering Department, University of Perugia, UdR INSTM, Strada di Pentima 4, 05100 Terni, Italy*
[3]*Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Beauchef 850, 8380492 Santiago, Chile*

lmanchado@ictp.csic.es

Abstract

Rubbers, or most specifically called elastomers, are one of the most important commercial polymers for several applications in many sectors, such as automotive, industrial, packaging, healthcare and many others. They are formed by long chains with high molecular weights crosslinked at many points giving rise to the formation of a three-dimensional network structure. Their general characteristics involve elastic behaviour and high reversible deformation properties. The material recovers its original form once releases the stress that deform it.

The elastomers are soft and weak materials with a low modulus and strength. They usually require the inclusion of fillers to improve the physical and mechanical properties of the compound. However, a minimum of 30–40 wt.% of conventional fillers such as carbon black or silica is needed to increase the properties, but, this high concentration reduces the processability of the compound and increases the weight of the material, limiting their applications.

Nanocomposites offer the possibility for new paradigms of material properties. Due to their nanometer phase dimensions, polymer nanocomposites exhibit unique properties even by the addition of small amount of filler, not shared by conventional composites. The inclusion of carbon nanoparticles, carbon nanotubes or graphene, produces a multifunctional material, since not only increases the mechanical behaviour but also provides particular properties such as electrical and thermal conductivity, barrier properties, thermal stability, etc [1-3]. The stronger filler/matrix interaction at the interface leads to a more immobilized rubber shell compared with filler particles of micro dimensions.

Potential applications of carbon nanoparticles filled elastomer composites can be as sensing devices, electrical shielding and electrical heating equipments.

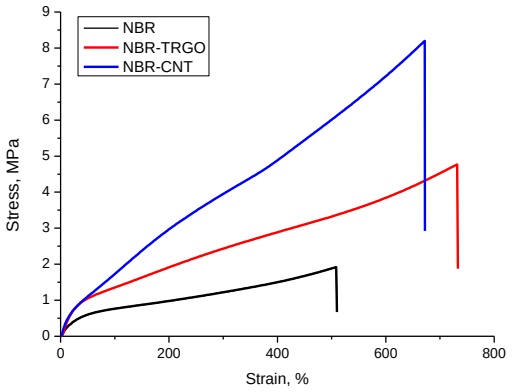

Figure 1: Stress-strain curves of carbon nanoparticles-NBR nanocomposites

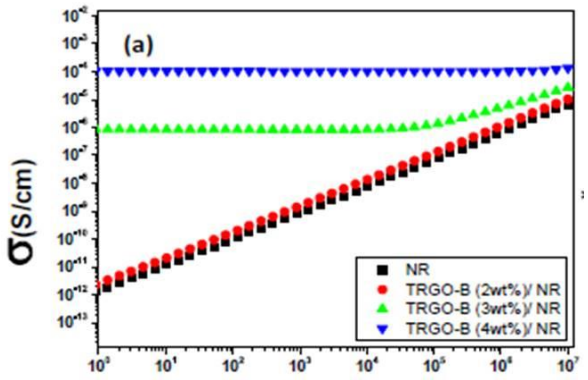

Figure 2: Electrical conductivity of graphene-natural rubber nanocomposites

References

[1] H. Aguilar-Bolados et al. Composites Part B, 87 (2016), 350-356

[2] H. Aguilar-Bolados et al. Composites Part B, 109 (2017), 147-154

[3] L. Valentini et al. Composites Science and Technology, 10.106/j.compscitech.2018.01.050