

# Rubber Nano(composites) with Self-healing Capability

**Marianella Hernández Santana**

Javier Araujo-Morera, Saúl Utrera-Barrios, Raquel Verdejo, Miguel Ángel López-Manchado

*Institute of Polymer Science and Technology (ICTP-CSIC), c/Juan de la Cierva 3, Madrid 28006, Spain*

[marherna@ictp.csic.es](mailto:marherna@ictp.csic.es)

Self-healing materials have intensively been investigated over the past 15 years. Several approaches have been developed, resulting in materials capable of dealing with damage events in an independent way, thereby extending their service life, and thus reducing waste. Healing is especially challenging in vulcanized rubbers, where the confinements imposed by the high density of cross-links restricts polymer chains to diffuse and form new bonds across former (pre-) fractured surfaces.[1] We will discuss the development of rubber composites with self-healing properties.[2] Many studies covering the healing of polymer composites report on the repair of structural properties and on the use of reinforcing agents (e.g. nanofillers) for improving the mechanical performance. However, nanofillers can also be used for restoring other functionalities, such as thermal or electrical conduction. Our aim is to restore more than one functionality after healing a macroscopic damage in rubber nanocomposites.[3] We also focus on the development of rubber composites combining self-healing properties with the use of ground fire rubber (GTR) as alternative sustainable filler.[4] These results will be seen as a starting model material for developing new sustainable applications economically and environmentally convenient targeting the tire industry.

## References

[1] Hernández Santana, M.; den Brabander, M.; García, S.; van der

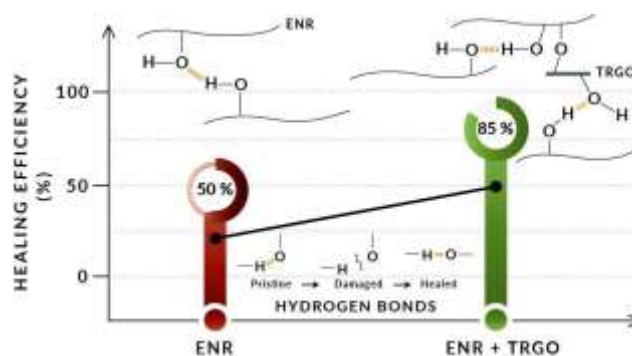
Zwaag, S., *Polym Rev*, 58 (2018) 585-609

[2] Utrera-Barrios, S.; Hernández Santana, M.; Verdejo, R.; López Manchado, M.A., *ACS Omega*, 5 (2020) 1902-1910

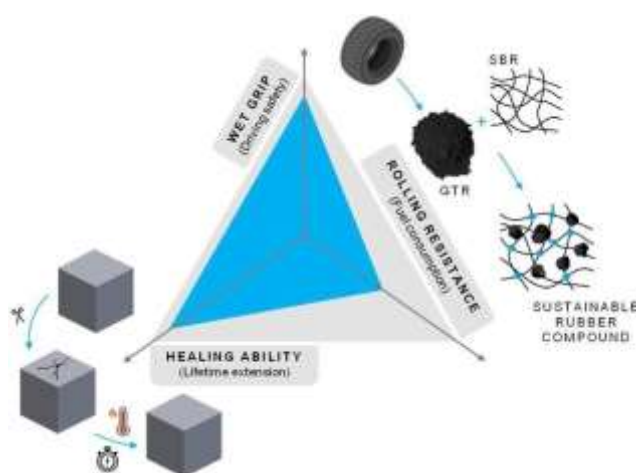
[3] Hernández, M.; Grande, A.M.; van der Zwaag, S.; García, S., *Smart Mater Struct*, 26 (2017) 085010

[4] Araujo-Morera, J.; Hernández Santana, M.; Verdejo, R.; López Manchado, M.A., *Polymers*, 11 (2019) 2122

## Figures



**Figure 1:** Epoxidized natural rubber (ENR)-Thermally reduced graphene oxide (TRGO) nanocomposites with healing capability



**Figure 2:** Magic triangle of tires of styrene-butadiene rubber (SBR)-ground tire rubber (GTR) compounds