

Graphene-enhanced elastomers and their applications

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Elastomers, particularly natural rubber, are widely used in applications such as tires, gloves, clothing, medical devices, etc. Elastomers, as the name suggests, are characterised by extremely high elasticity, often combined with moderately high strength. However, the composition and chemistry of commercial rubbers has remained more or less unchanged for decades.

We demonstrate that the mechanical properties of elastomers can be improved by the incorporation of graphene fillers. Elastomers are compounded either an aqueous formulation called a latex, or as a solid. In order to maximise the impact on mechanical properties by the addition of a small volume fraction of graphene, it is essential to ensure uniform dispersion of the graphene flakes in the elastomer matrix. Upon optimisation, it is possible to improve an elastomer by making it simultaneously 50% stronger, 50% more elastic and 50% more hard wearing.

A graphene-modified elastomer can then be formed into a number of shapes using, most popularly, dip-moulding of latex or compression moulding of solid rubber. I will discuss the fabrication and testing of dip-moulded elastomer-graphene composite products [1] such as condoms and gloves, as well as compression moulded products such as shoe soles [2].

Lastly, I will present the specific case of athletic footwear, where the rubber-graphene composite gives markedly

improved grip on tough terrains while simultaneously improving durability. The graphene-enhanced athletic shoes from Inov-8 Ltd. have been available for purchase, worldwide, since July 2018.

References

- [1] Iliut, M.; Silva, C.; Herrick, S.; McGlothlin, M.; Vijayaraghavan, A.; *Carbon*, **2016**, 106, 228.
- [2] Iliut, M.; Sheridan, D.; Vijayaraghavan, A.; *Submitted*.

Figures



Figure 1: Dip-molded graphene-elastomer thin film samples with increasing graphene content (Left to right).



Figure 2: Graphene-rubber composite sole footwear (Inov-8 Ltd.).
