Development of Multifunctional Natural Rubber Graphene Nanocomposite Foam

Akash Ghosh [a,b]
Titash Mondal[b]*, Aravind Vijayaraghavan[a]*
[a]*University of Manchester, Manchester, United Kingdom*
[b]*Indian Institute of Technology Kharagpur, Kharagpur, India*
akash.ghosh@postgrad.machester.ac.uk

In the pursuit of lightweight, multifunctional materials for modern technological applications, polymer-based nanocomposites have emerged as effective alternatives due to their processability and low weight. Among these, nanocomposite foams have gathered significant attention owing to their versatile structure and properties. This study focuses on optimizing nanocomposite foams by incorporating natural rubber and graphene to enhance mechanical, electrical, and dielectric properties. These results highlight the potential of natural rubber-graphene nanocomposite foam as a lightweight and efficient solution for modern electronics, aligning with sustainability trends. This research advances lightweight, multifunctional nanocomposite foams for next-generation electronic applications and flexible devices. The methodology involves mechanical melt mixing of rubber, controlling the incorporation of graphene nanoplatelets (GNP) and the foaming agent Dinitrosopentamethylenetetramine (DNPT). The different characterization tools used to analyze morphology, microstructure, and the electrical, impedance, and mechanical characteristics. The optimized foam formulation, incorporating graphene masterbatch in natural rubber, achieves a low density of 0.34 g/cc. The foaming of rubber using DNPT forms a conductive network of graphene. This nanocomposite foam exhibits a compressive modulus of 5.21 MPa, electrical conductivity of 10^{-9} S/cm, and a specific EMI shielding effectiveness of 136 dB.cm²/g. Moreover, leveraging its excellent compressibility, the nanocomposite foam can recover 62.5% after 72 hours of constant compression.

References

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Figures

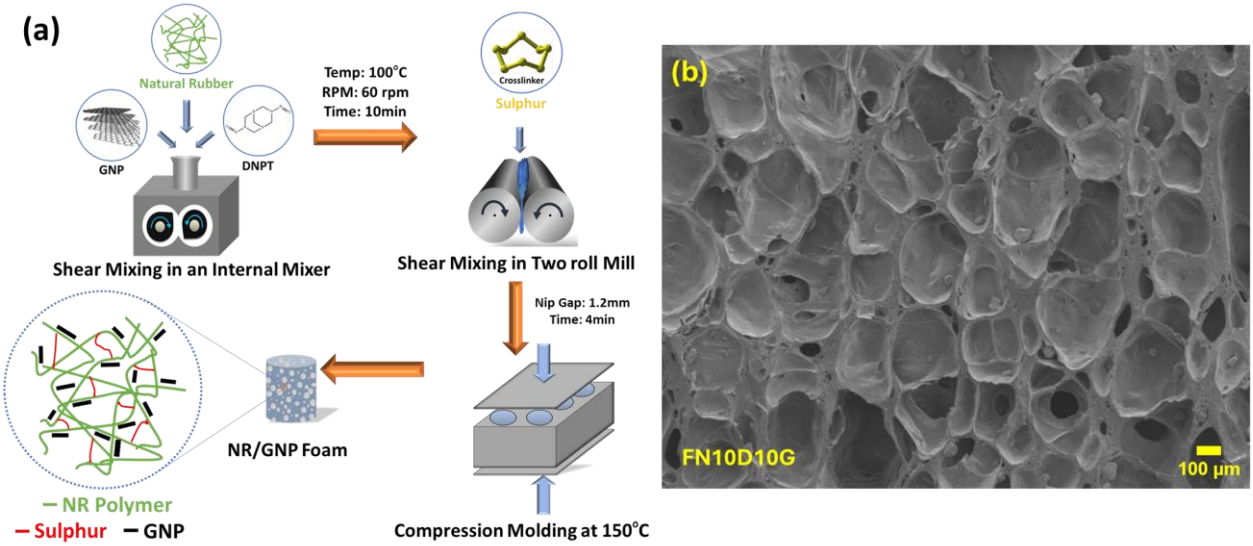

Figure 1: (a)Schematic Diagram of fabrication for the Natural Rubber Graphene Nanocomposite Foam (b) SEM image of cell morphology of NR/GNP foam at 10 phr of filler loading