

Supramolecular functionalization of graphene related materials for heat transfer applications

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Graphene nano-papers fabricated from Graphite nano-Platelets (GnP) have extraordinary thermal properties related to unique intrinsic thermal conductivity of individual graphene sheets [1] showing potential in thermal management applications.

In order to preserve the high conductivity associated to defect-free sp² structure decreasing the interfacial thermal resistance between nano-platelets [2], non-covalent functionalization was performed employing a new class of organic compounds BisPyrene-based (BP), synthesised on purpose, where the polycyclic aromatic hydrocarbons (PAHs) π - π interact with graphene surface [3] as anchor group (Figure 1).

The aim of this work is to build molecular junctions between GnP, to enhance the thermal conductance at the interface, aiming to fabricate higher efficiency nanopapers exploitable as heat spreader. Supramolecular functionalized GnP (s-GnP) were characterized by UV-Vis, fluorescence and Raman spectroscopy, confirming the formation of a GnP linked network by BP molecules. In particular, BP molecules with different length were synthesized and the relationship between structures and thermal properties were investigated by X-ray diffraction (XRD) and Light Flash Analysis (LFA). Nanopapers prepared by gravimetric filtration with the functionalized GnP showed higher thermal diffusivity for shorter BP's junctions (Figure 2).

Finally, nanopapers were validated as heat spreaders used to cool down an electronic component, evidencing better performance than Cu and Al (Figure 3), most commonly used as spreader in electronics.

References

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- [2] W. Feng, M. Qin, Y. Feng, *Carbon* 109 (2016), 575
- [3] N.J. Silva, F. B. C. Machado, H. Lischka, Adelia J. A. Aquino, *Phys. Chem. Chem. Phys.*, 18, (2016), 22300

Figures:

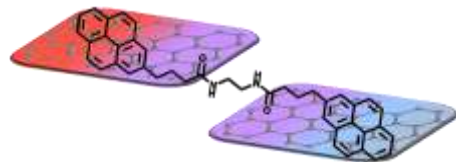


Figure 1: Schematic molecular junction related to π - π interaction between Bis-pyrene and GnP.

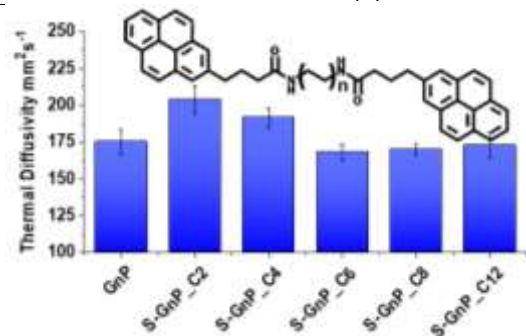


Figure 2: Thermal diffusivity results for functionalized vs pristine GnP nanopapers

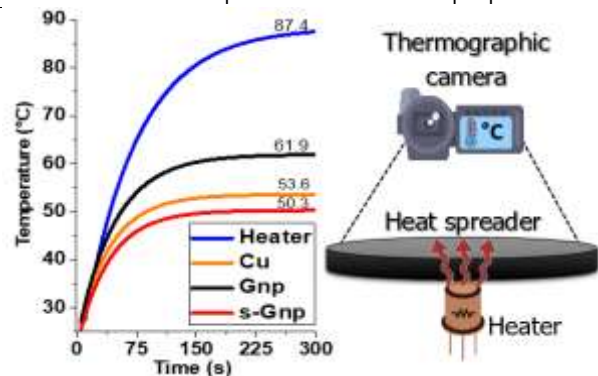


Figure 3: Monitoring of heat spreader properties by thermal imaging camera