Graphene/methacrylic derivative of Cyrene™ Polymer Composites: Improved Dispersal for Thermal Conductivity

PHYSICAL SCIENCES: Materials

The Challenge	The poor dispersal of graphene in polymers results in composite products that do not realize graphene's superior properties of electrical and thermal conductivity, particularly in the planar direction.
The Solution	Cyrene™ is a green solvent capable of very good graphene dispersion in solution. We have developed a methacrylic derivative of Cyrene™ monomer and have demonstrated that this derivative retains the good ability of Cyrene™ to disperse graphene through the subsequent polymerisation process. This leads to well-dispersed graphene in a polymeric matrix that can be used to make superior heat- or electrically-conductive polymer composites.
Key benefits	• Allows good dispersion of graphene in a polymerisable monomer • Higher amounts of graphene (ca. 20%) can be dispersed • Good through and in-plane heat transfer possible, depending on processing method
Development Stage	Proof of Concept completed
Brief Description & Differentiation	• New methacrylic monomer from Cyrene™ produced from a low volatility, green solvent derived from cellulose waste • Homopolymer glass transition temperature (T_g): 162°C for bulk polymerization and 193°C for emulsion polymerization - believed to be one of the highest reported for methacrylic polymers • Readily copolymerised to modify properties • New polymer provides good dispersion of graphene for thermal conductivity
Research Team	Led by Assoc Prof Kei Saito (School of Chemistry, Monash University), Prof George Simon (Department of Materials Science, Monash University) and Michael Gurin
Intellectual Property	US provisional patent application filed.

Figure 1. Photographs of the composites

Table 1 Thermal conductivity results

Entry	Graphene Content % wt	Graphene Type	Through-plane Thermal Conductivity k (W/mK)
1	1.5	Aldrich 15u	0.497
2	5	Aldrich 15u	0.849
3	10	Aldrich 15u	0.892
4	20	Aldrich 15u	1.360