**Isocyanate Functionalised Graphene for the Facile Development of Graphene Composites.**

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Introduction.

Isocyanate treatment of graphene oxide was first demonstrated by Stankovich *et al*.1 as the first example of complete exfoliation of chemically derivatised graphite oxide in organic solvent. This process also allowed the incorporation of additional functionality into the graphene oxide. To the best of our knowledge, isocyanates have not been utilised to functionalise graphene. This has the potential to provide a simple method to create covalently bound polymer composites.

Aim.

The aim of this project was to prepare isocyanate functionalised graphene, and incorporate it into a polymer backbone through covalent bonding to enhance the mechanical, thermal and electrical properties of the polymer. The use of graphene, rather than graphene oxide, circumvents the issue of high defects, poor electrical conductivity and *sp3* bonds present in resulting graphene polymer composite.

Results and discussion.

The reaction of a diisocyanate with chemically converted graphene was successful, and gave a very reactive isocyanate tether in place for further functionalisation.



The graphene isocyanate was then incorporated into the synthesis of polyurethanes, functioning in an analogous fashion to a diisocyanate used in the polymerisation process, and resulting in the graphene being covalently bound into the polyurethane backbone dramatically affecting the properties of the polyurethane.

The graphene isocyanate could also be covalently bound to a range of textiles towards the development of washable electronically and thermally conductive clothes and devices.

References

1. Stankovich, S., Piner, R. D., Nguyen, S. T., & Ruoff, R. S. (2006). Synthesis and exfoliation of isocyanate-treated graphene oxide nanoplatelets. Carbon, 44, 3342-3347.