A novel method for converting natural graphite into highly porous graphene films with advanced applications including energy storage. The highly porous nature of the gel films allows for additional functional materials to be added between the individual graphene sheets, offering opportunity for a range of applications.

- Electrically conductive
- Removal of drying step
- Open and continuous porous structure
- Able to incorporate further functional materials
- Favourable for many practical applications

**THE CHALLENGE**

Many applications of graphene-based materials involve the use of graphene assemblies. Currently, the most scalable and cost-effective method for large-scale production of graphene is the graphite oxide route. This involves oxidation of graphite to graphite oxide, followed by chemical or thermal exfoliation/reduction to graphene sheets. The final products are supplied in dried and solid state. However, previous studies have shown that when graphene sheets are assembled together to form a solid film, a large portion of its surface area will be blocked due to aggregation, limiting the performance of graphene-based devices/materials. This may generate non-uniform stresses in the green body, leading to loss of properties and defects such as cracks. In turn, this limits applications of current graphene sheets in a number of areas.

**THE TECHNOLOGY**

The performance problem faced by graphene sheets currently in use is solved by the new approach proposed here. The key concept is to process chemically prepared graphene dispersions into a gel film form, instead of dried films or powder that are traditionally adopted. In the graphene gel, individual graphene sheets are interconnected, forming films with a reasonable mechanical strength; each sheet is physically separated by an entrapped liquid or due to its corrugation. Many other functional materials can be added into graphene-based gel films during the synthetic process or by post-addition, to further expand or enhance their applications, significantly reducing the aggregation.

**Applications**

- Energy Storage (e.g., capacitors, batteries and fuel cells)
- LCD displays and photovoltaic devices
- Composites for volatile fuel storage containers and electronics packaging
- Absorbents for water purification and chemical separation
- Printable conductive inks

**Intellectual property:** The technology is protected by a number of National Phase patent applications, to cover all significant global markets.

**THE OPPORTUNITY**

Monash seeks a partner for licensing and further development of the technology into practical applications for the market. The Monash Research team is led by Professor Dan Li who has significant experience in this area.

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