APPLIED GRAPHENE MATERIALS

Enhancing the Performance of Coatings with Biobased Graphene Dispersions

Adam Bell
Senior Development Technologist

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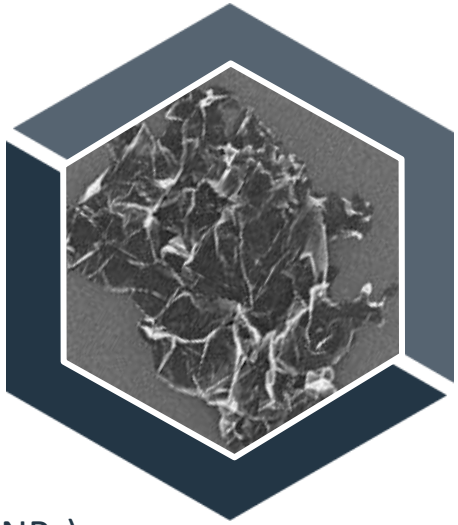
appliedgraphenematerials.com

Production and Characterisation of Graphene Nanoplatelets

Graphene as a 2D nanomaterial has been extensively researched as a new additive to improve **barrier performance**, **reduce corrosion** and **extend service life** in protective coatings.

- Typically **3 - 5** Atomic Layers Thick
- **4 nm** Platelet Thickness
- **5%** Oxygen Content

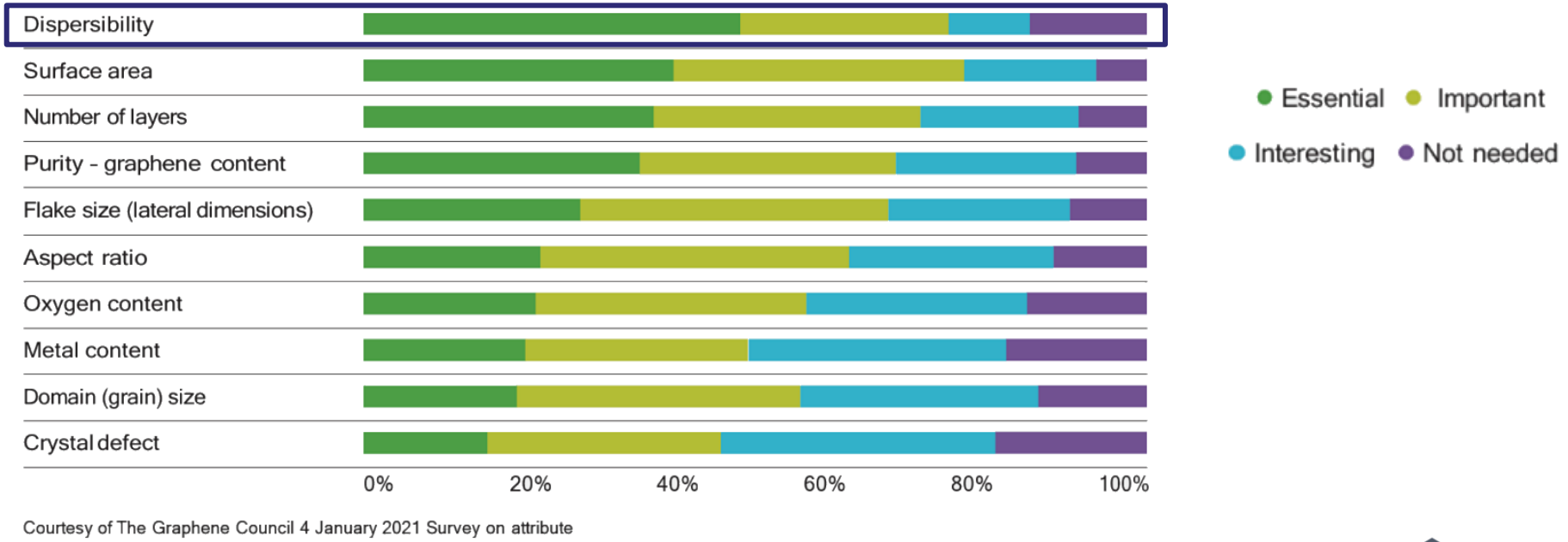
- Surface Area of **300m²/g**
- Tap Density **9g/l**



AGM's patent-protected technology produces Graphene Nanoplatelets (GNPs) that are approximately **25,000 times** thinner than a human hair!

Dispersion is Key to Achieving Performance

Research has shown that the **dispersibility** of graphene nanoplatelets is essential to achieving success in an application…



Courtesy of The Graphene Council 4 January 2021 Survey on attribute

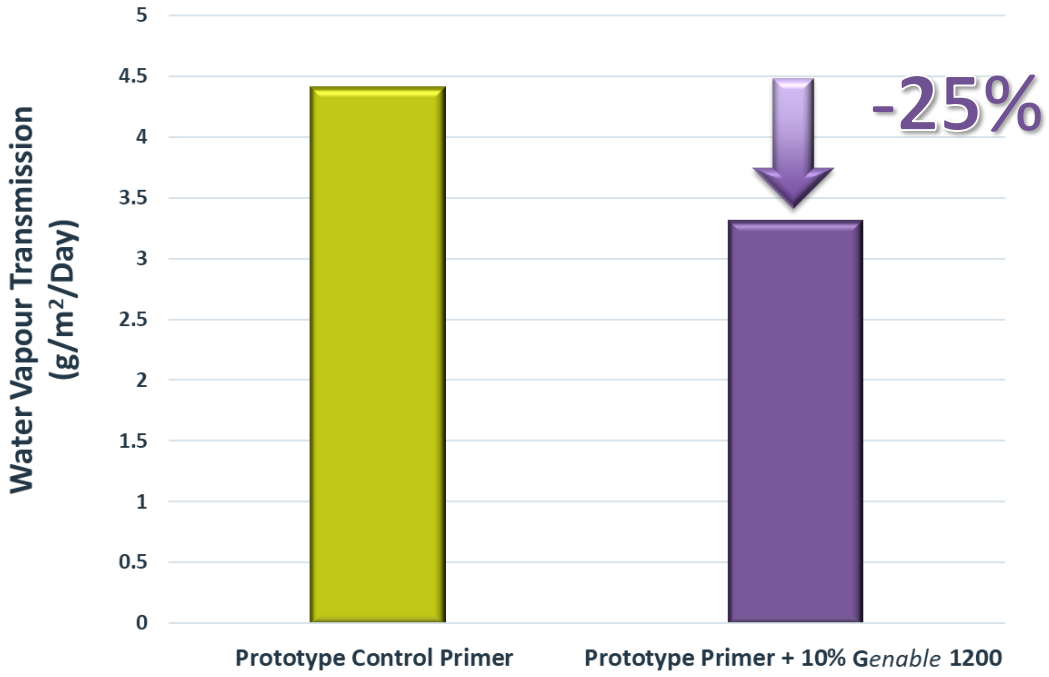
Challenges of Dispersing Graphene

Poor quality dispersions can result in a significant number of issues including:

- In-can instability of the dispersion on **storage**.
- **Incompatibility** with test coating systems cause potential incorporation issues during the addition of a dispersion to the coating, and could impact the longer term in-can stability of the system.
- Destabilisation can result in the dispersion particle size increasing over time due to **agglomeration** and **aggregation** - this is likely to result in a drop in performance compared to a dispersion with a stable and optimised particle size distribution (PSD).

Reduced Water Vapour Transmission

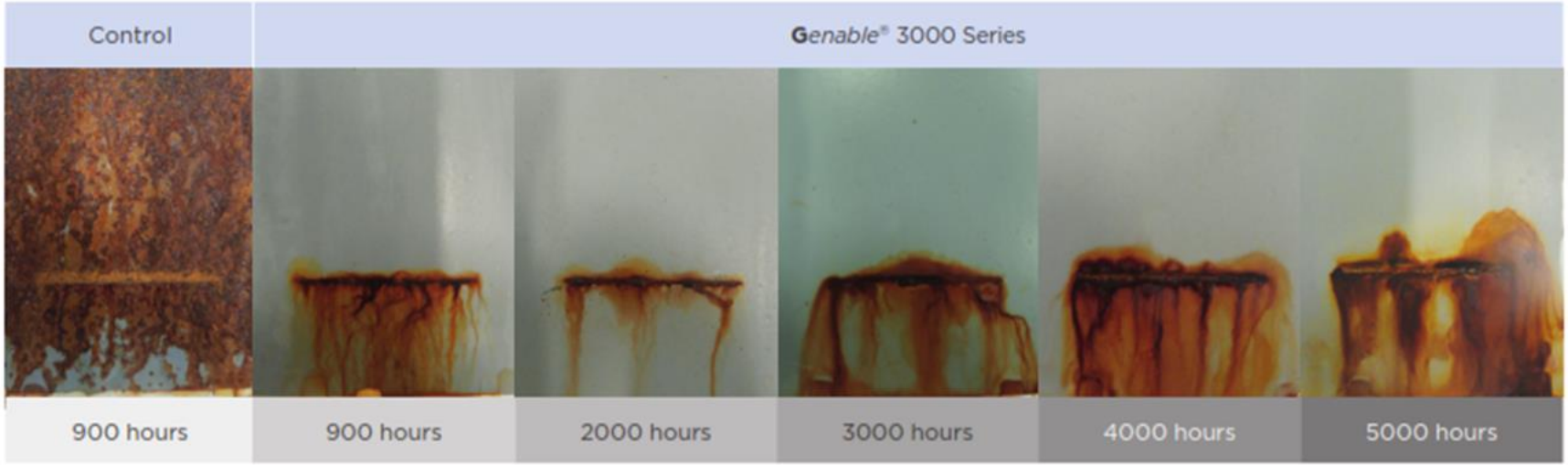
- Using a combination of the **2D** molecular structure and **high aspect ratio** of its graphene nanoplatelets, alongside **optimised dispersion technology**, AGM has demonstrated significant reductions in water uptake in epoxy resins.



Improved Corrosion Resistance

Example Coating Performance in Prohesion Salt Spray

- Graphene can improve the **anti-corrosion** properties of both **solvent** and **waterbased** coatings.



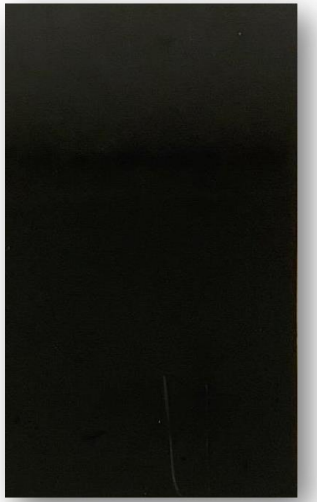
Increased Chemical Resistance

Example Coating Performance in Lactic Acid – 28 Day Immersion

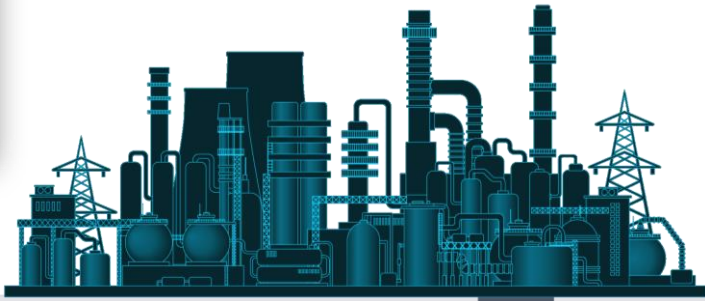
- Visually clear with **less blistering**, a marked improvement in **gloss retention** and **hardness.**

Complete coating failure of glass flake control system

Glass flake + **G***enable* graphene dispersion hybrid system



G*enable* graphene dispersion system



Enabling Sustainable Innovation

Graphene can contribute to achieving **sustainability goals** as an alternative to traditional chemicals.

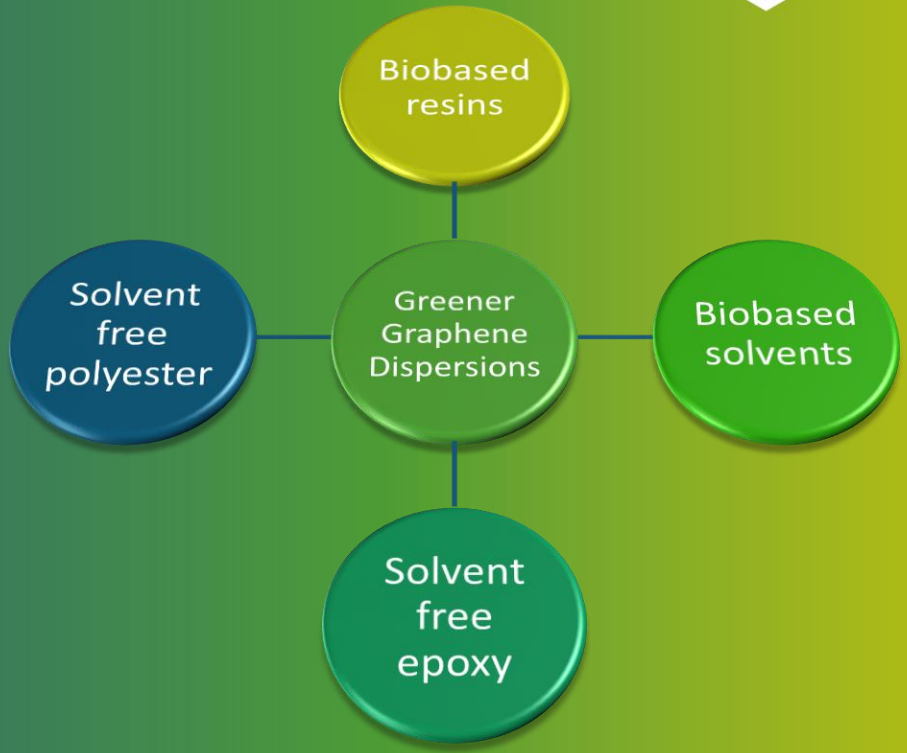
- Product life cycle advantages.
- Extension of coating life through improved performance, resulting in lower maintenance requirements and a potential reduction in microplastic release.
- Potential reduction of pollutants such as heavy metals, zinc phosphate, chromates etc.

Reducing Environmental Impact

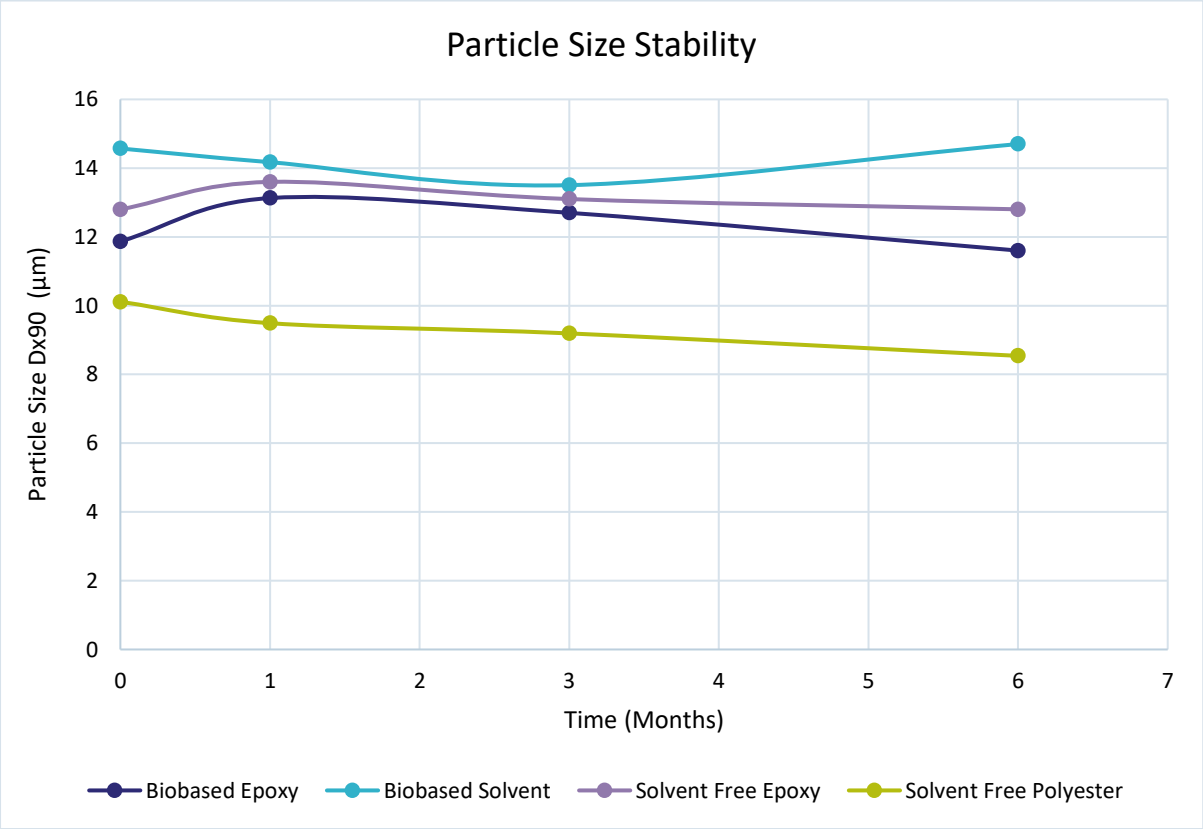
- We strive for continuous improvement with regards to reducing our carbon footprint.
- We are enabling industry to innovate with graphene dispersions, offering customers the opportunity to develop products with a lower environmental impact.
- With an increasing focus on sustainability within the paints and coatings market, we have developed a range of ecofriendly dispersions of graphene.

Experimental

- Graphene nanoplatelets were dispersed into various eco-friendly resins and solvents.
- Samples were stored under ambient lab conditions and stability was monitored over a period of 6 months
- Viscosity was recorded at time = 0 and then at 1, 3 and 6 months.
- Particle size was recorded at time = 0 and then at 1, 3 and 6 months (particle size was measured using differential light scattering).

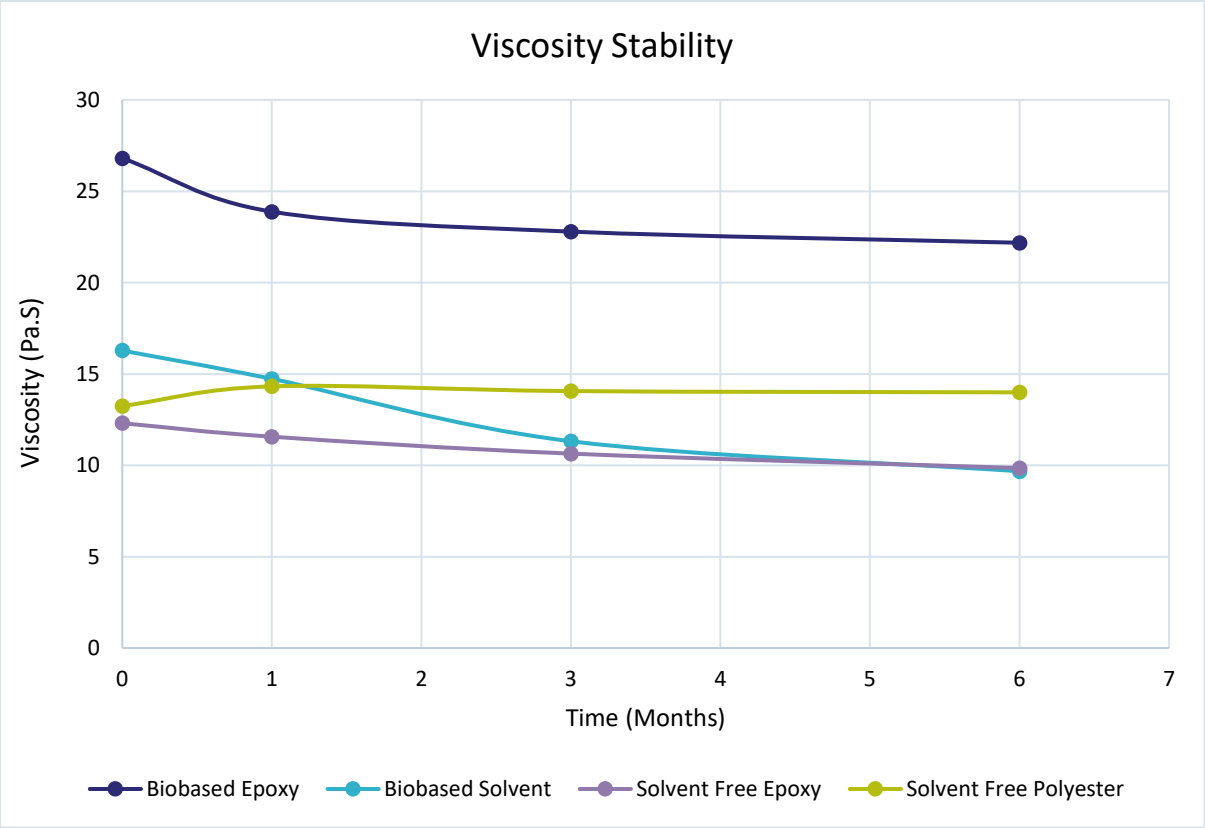


Stability of Graphene Dispersion in Different Media



- Measured using differential light scattering.
- Dispersions tested in a biobased epoxy, a biobased solvent, a solvent free epoxy and a solvent free polyester.
- All test samples demonstrated stable particle sizes after 6 months.

Stability of Graphene Dispersion in Different Media



- Determined using a shear rate sweep (values reported at $10s^{-1}$ at 25°C).
- Dispersions tested in a biobased epoxy, a biobased solvent, a solvent free epoxy and a solvent free polyester.
- All test samples demonstrated stable viscosity after 6 months.

Summary and Conclusions

Conclusions

AGM has developed novel graphene nanoplatelet dispersions:

- **Easy to handle** and **safe** to incorporate into existing industrial systems.
- **Long-term stability** of standard dispersion products.
- **Optimised** for specific final application.
- **Eco-friendly**, **biobased** and **low VoC** options.

Enabling industry to benefit from the potential of graphene in a **simple**, **safe and easy to formulate** way.

Conclusions

- As the coatings industry moves towards **sustainable** and **environmentally beneficial** technologies, graphene is a **viable alternative** to traditional additives.
- Graphene nanoplatelet dispersions offer coatings formulators a **toolbox technology**, giving them the opportunity to offer their customers a new **innovative solution** to **combat corrosion** and **chemical resistance** in real world applications.




Further information

Get in touch

www.appliedgraphenematerials.com

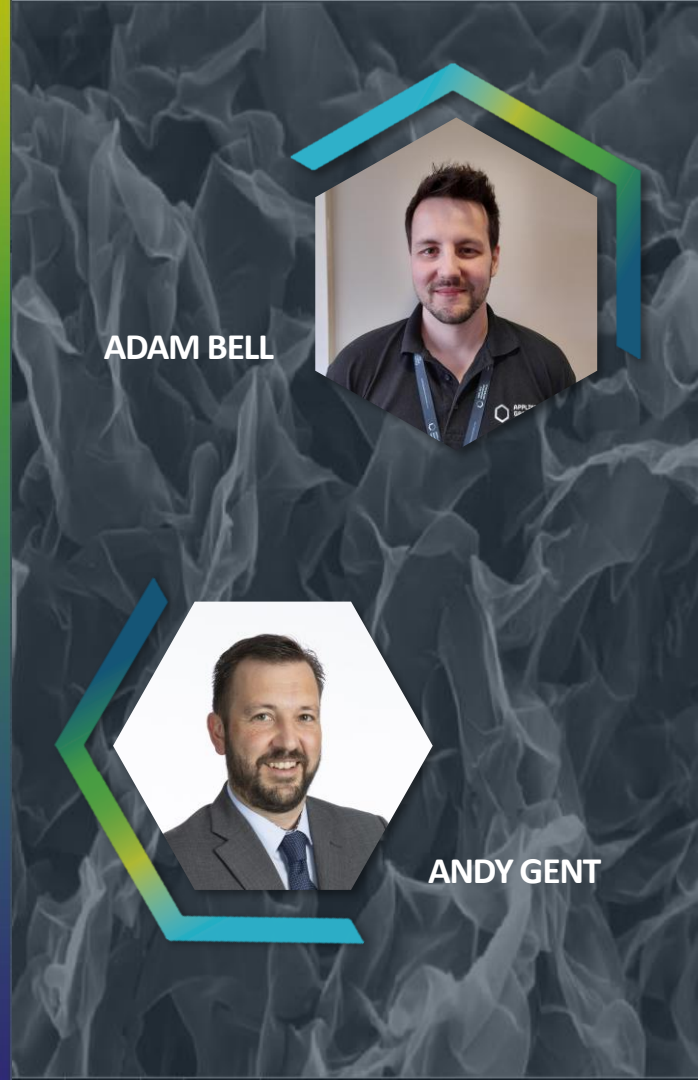
+44 (0)1642 438214

info@appliedgraphenematerials.com

Adam Bell, Senior Development Technologist
adam.bell@appliedgraphenematerials.com

Andy Gent, Commercial Director
andy.gent@appliedgraphenematerials.com

Follow AGM on LinkedIn
applied-graphene-materials



CONTACT INFORMATION

Applied Graphene Materials plc
The Wilton Centre, Redcar,
Cleveland, TS10 4RF

+44 (0)1642 438214
info@appliedgraphenematerials.com