GEIC and Haydale Open Day 2019 Introduction to Haydale

Creating Material Change

GBR 99



First isolated at **The University of Manchester** in 2004;

Prof <u>Andre Geim</u> and Prof <u>Kostya Novoselov</u> who received The Nobel Prize for Physics in **2010**.

What is Graphene?

Graphene sheets are a 2D allotrope of hexagonal carbon atoms.

- 200x stronger than structural steel.
- A better conductor than copper.
- Thermal management – out performs all other materials.





COMPANY OVERVIEW

Graphene time line and Haydale time line



Progress to commercialisation similarity.

Here, and here to stay.

These materials have moved through an R&D cycle: 13 years ago, identification & research

> extraordinary attributes led to wide ranging and sweeping claims.

years ago, focus on development

> targeting those attributes and understanding where and how they can be applied.

Haydale through R+D phase.

now users actively engaged on practical targeted applications

deployment has started.

Haydale moved to **commercial** focus.

Graphene is now, following many years of testing, starting to be deployed across a number of industries.

Significant UK government and public investment to research graphene and other 2D materials, identifying commercial opportunities.

COMPANY OVERVIEW

Haydale company timeline

havdale



Becoming global leading to the current structure...





Increase technical performance and reduce cost across a multitude of industries.

Graphene and other Nanomaterials	Benefits	
1. Produce tailored advanced materials.	Enhance the quality and performance of our customers' products.	
2. Manufacture unique, proprietary silicon carbide fibres and whiskers.	Strengthen ceramics and enable highly scratch and wear resistant coatings.	
3. Offer graphene enhanced polymers for additive manufacturing.	Better products with reduced production times.	
4. Develop graphene enhanced resins for prepreg carbon fibre market.	Deliver enhanced electrical, thermal or mechanical performance to hi-tech industries.	
5. Formulate proprietary graphene based inks and coatings.	Reduce cost and improve data quality, including regulatory approved ink for biomedical sensors.	

Our expertise and USP is in our patented Functionalisation process.



Engineering and design applications expertise to deliver the improvements you seek.







Our HDPLAS® process delivers a growing portfolio of (MATech[™]) products with unprecedented performance.

Supply Chain

The right material with the right level of functionalisation is essential for the specific application or product.

We supply the most appropriate feedstock. Our process is independently verified by the National Physical Laboratory.

Material

Graphene and many other nano particles do not mix naturally with other materials.

Chemistry



To ensure graphene's superior properties can be blended into our customers' products, compatible chemical groups are added to the material surface to enable effective dispersion of the graphene ('functionalised').

Level



Our patented HDPLAS® low temperature plasma process offers the most effective method of achieving this nanomaterial functionalisation and harnesses the true potential of graphene.



Our technology: the advantages

havdal

Fast, cost-efficient supply of tailored solutions to raw material suppliers and product manufacturers.



We are a trusted partner to our customers, putting quality, performance and customer service at the heart of everything we do.



OUR TECHNOLOGIES/PRODUCTS

Aerospace



Current Partners:

Aerospace

Graphene and other nanomaterials will herald the next major evolution in aerospace materials.



OUR TECHNOLOGIES/PRODUCTS

Automotive

World first with BAC Mono supercar – use of graphene in wheel arches and diffuser body panels. Overall increased mechanical performance and weight reduction. Current Partner:



Opportunities/Applications Haydale and BAC:



Commercialisation of graphene and other nanomaterials.



Printed sensors using graphene based inks in vehicle diagnostics.



Provide driver/ vehicle interfaces.

Outcomes

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Weight reduction.

Design optimisation.

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Improved vehicle performance.

Improved driver safety.





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OUR TECHNOLOGIES/PRODUCTS

Lighter, faster, stronger...

Gain that all important competitive edge. Enhanced performance and safety.

Opportunities/Applications

Tennis / Lacrosse lighter more resistant racquets/enhanced weight distribution and energy transfer.



Cycling stronger, lighter frames use in helmets and apparel / improved performance and safety.

Sports



Skiing improve dynamic performance of skis/Lighter, faster and more responsive product.





Current Partner:

NCPC



OUR TECHNOLOGIES/PRODUCTS





VCPC

Leading the way in optimisation of graphene based inks for biosensor devises. Helping to create environmentally friendly biosensors.

Current Partner:



Opportunities/Applications



Innovation in diagnostic sensors – diabetes.

Outcomes



Increased patient empowerment.



Increased accuracy of readings/ impact on diabetes stats....



Innovation in how

data is collated/read.

Reduced cost of sensors.





Improving the speed, quality, strength and accuracy of printing.

Current Partner:







COMPANY OVERVIEW

Recent highlights: Haydale 2018/19



A transitional year- Strategic focus on commercialisation.

Changes implemented include:

Commercial paid for projects:

Haydale continues to work closely with customers to consult on product and process development.

The team globally during the past 12 months has worked to develop key product IP whilst generating revenue for the group.

Product focus:

Haydale have over 2018-19 has focused on the development of composites, ink/Coating & Silicon carbide products which have demonstrated positive commercial uptake during the year.

Haydale through expansion within its sales and marketing team, the team has focused on key customer accounts to develop a road map for strategic growth.



Board and operational restructure:

Identification of the need to restructure the group organisation to move to a product focused commercial business. Which will support Haydale's drive for a EBITDA positive position.

Organisational changes to support include :

Keith Broadbent appointed Chief executive officer. Delivering on product sales within UK & group now a major focus. Commercial sales of Nano enhanced carbon fibre pre preg products & Ink/coating products. Plasma functionalisation optimisation-Advance and enhanced functional groups.



- Management change made to deliver on forecasts, including reductions in central overheads and plc costs by £1 million.
- US SiC business now ready to deliver material returns following major investment in 2018 in its new markets (blanks) (Aerospace tooling / coatings – with Silicon Carbide).
- Bespoke Functionalised inks in Far East and UK continue to add repeat customers and we believe the first significant graphene-related sales in volume.
- Bespoke Functionalised masterbatches in composites, resins and polymers similarly give significant growth opportunities.
- The USP of Haydale remains in it functionalisation process which has improved in a major way over the last twelve months.
- The partnership with the GEIC and their professional team and facilities in place gives Haydale the opportunity to speed up the commercialisation process now underway.
- The ability to scale up to industrial level volume which this process is developed and makes Haydale is ready for the next step.
- Our partners will help this next stage development.

Thank you

