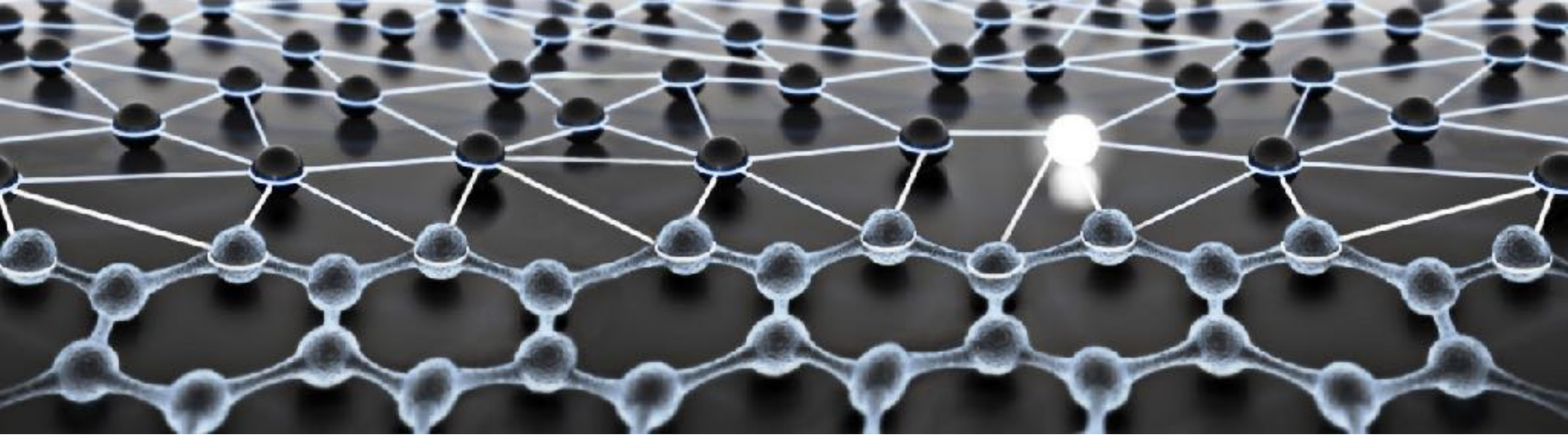

HVM NEW MATERIALS 2019
6-7 NOVEMBER #HVMGNM19 CAMBRIDGE

5th HVM New Materials Conference, Showcase & Technology Briefing Day **www.cir-strategy.com/events**

Day 1
Session 1 Notes
Developments in Graphenes
Prof. Andrea Ferrari, Director, Cambridge Graphene Centre

- **Graphene is now past the peak of inflated expectations in the Hype Cycle**
- **IBM's memory of the hard disk drive (HDD) – developed in 1956, weighed over a ton, 5MB data memory (IBM350), without carbon over coat**
- **Today - memory increased to 10Tb/in2 with carbon over coat**
- **Thinner carbon over coat achieved from 7-9nm in 1998 to 2.5-3 nm in 2016**
- **Thinner the carbon coating higher the storage**
- **Optimum thickness - <2 nm**
- **Friction, wear, corrosion, and thermal stability - important.**
- **Carbon over coat <2nm – damaged protective properties of carbon over coat**
- **2-4 layers of graphene - reduction in friction and provide better corrosion and wear than carbon over coat**
- **Production of graphite from SiC by Acheson in 1896 for lubricant applications**
- **Cost-effective, large scale graphene with AIXTRON and Neutron systems.**
- **AIXTRON - large-scale production of graphene through chemical vapour deposition (CVD)**
- **Neutron - a roll-to-roll system capable of depositing large areas of graphene on metal foils under ambient conditions**

Day 1
Session 1 Notes ctd.
Developments in Graphenes
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- **Placing Graphene on the hype cycle curve using example of magnetic storage, evolution of carbon coated data storage discs**
- **trade-off between thinness of deposited graphene layer (higher readability by head media) and thermal vulnerability (data loss within 1 yr likely at 1 layer of graphene coating)**
- **Cambridge working on dynamic solution (HAMR), periodically changing between heated state (warm + soft = easy data reading) and cooling (cool + hard = reliable data storage capacity)**
- **mechanical proof of concept and proof of resilience well advanced; graphene can withstand laser treatments inherent in HAMR and at 2 layer thickness can also cover any substrate wrinkles (which could leave to deposition irregularities sand/or bare patches at 1 layer)**
- **Business case for graphene: no point in replicating what existing technology already does quite well, graphene needs to spawn its own innovative applications**
- **Main challenge: how to get form lab (where you can now make any graphene-related gadget you dream up) to real-world fabrication and use at scale.**