

Graphene Monoxide, the New Semiconductor for Electronics

(OTT ID 1294)

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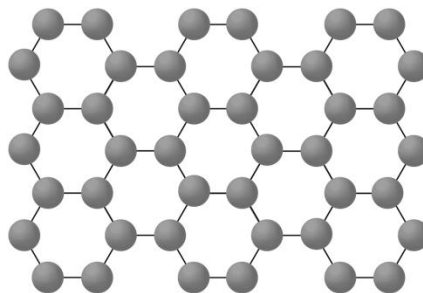
Problems/Unmet Needs:

- Graphene is a material that has a large range of applications due to its properties
 - Better electron mobility than any metal
 - High flexibility
 - Stronger than steel
 - One atom thin
- Advances in production of graphene have created even more applications, especially in electronics
 - Shown to enhance batteries, solar cells, electronic transistors, and sensors
- Industry competitors seeking new ways to mass produce graphene-based materials
 - New processes developed in order to create new graphene-based materials
 - Price of material affected by production costs and quality of final product

Technological Solution:

- The inventors have created a new material, graphene monoxide (GMO)
 - Comprised of unique one-to-one carbon-oxygen structure with crystal ordering for both oxygen and carbon atoms
 - Theoretical band gap of ~ 0.9 eV
 - Adjustable band gap with capacity to span both direct and indirect semiconductor range
 - Precursor material used: graphene oxide
 - Process method can be adjusted to control location of GMO and the graphene-to-GMO content

- **Real-time Band Gap Tuning** – Applying a strain to GMO theoretically shifts the band gap
- **Mass Production** – Thermal reduction in vacuum method increases potential for mass production of GMO
- **Oxygen Tuning** – Water vapor can be used to tune the oxygen content during the production of GMO on Graphene Oxide
- **Future Applications** – Promising applications in nanoelectronic and electrochemical devices



- U.S. Utility Patent: Synthesis and applications of graphene based nanomaterials
 - [US2013-0344390](#)
 - Issued 2015
- The Inventors are currently looking for industry partners to test the materials in specific applications

Applications

- Semiconducting applications including diodes, transistors, and other components in digital circuits

Market

- Graphene monoxide could be used in semiconductor market
 - Expected to be a suitable anode for battery technologies
 - Expected to be suitable as electrode material for ultra capacitors
- World semiconductor market reached over \$27 billion as of April 2016
 - Market expected to grow at a moderate pace of 2.0% growth globally for 2017

- The properties of graphene-based materials make it a great candidate for semiconductor applications
 - Theoretical band gap of ~ 0.9 eV
 - Adjustable band gap with capacity to span both direct and indirect semiconductor range
- Process method can be adjusted to control location of GMO and the graphene-to-GMO content
 - Industry competitors seeking ability to mass produce high quality graphene-based products
- **Next Step: Seeking industry partners to test the materials in specific applications**

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