Photovoltaic Cells Using Hetero2D Materials

BACKGROUND

Graphene is a two-dimensional material, consisting of a single sheet of carbon atoms, with extraordinary conductivity and strength. Since graphene was first isolated at the University of Manchester, other 2D materials have been produced with differing electronic and mechanical properties. Examples include hexagonal boron nitride and molybdenum disulfide. Layering of different combinations into 'Hetero-2D Materials' allows properties to be tailored to suit numerous applications. Combining conductor and semi-conductor layers has enabled the creation of a 2D Photovoltaic Cell.

THE TECHNOLOGY

This technology is a 2D photovoltaic cell made using graphene sheets as transparent electrodes and transition metal dichalcogenides (TMDCs) as semi-conductor material. The single-atom layers have been mounted on thin silicon dioxide and silicon substrates for support to create a flexible but durable photovoltaic. Its photo-efficiency has been demonstrated at 30%, using laser-absorption, which is far higher than current commercial thin-film photovoltaics. Additionally, doping the graphene to increase electronic performance or adding plasmonic structures (such as gold nano-dots) to alter the optical properties are future avenues of research that may create other products in the same family of 2D semi-conductors. Finally, a novel fabrication process that enables easier preparation of 2D heterostructures has been developed.

KEY BENEFITS

- 2D photovoltaic material
- Very-high photo-efficiency in laboratory setting (30%)
- Small size and high flexibility
- Novel fabrication process allowing production of any 2D heterostructures
- Opportunity to alter optical and electronic properties of future models by doping the graphene or adding nano-dots

APPLICATIONS

- Thin solar panel coatings on buildings for power generation
- Chip-scale photodetector for silicon photonic applications
- Tunable solar-cells which could adjust their optical absorption by changing the doping of the top graphene layer – could be applied as tinted windows for example
- Flexible photovoltaic applications where polymer solar cells are unsuitable, such as solar panels in space where UV radiation levels are high

- The technology could be used to create heterostructures to act as optical fires with very finely tuned absorption bands, or as highly-selective membranes for gas separation, or to provide specific types of reinforcement in nanocomposites

RELEVANT PUBLICATION

- Britnell et al. 2013. Science, 340(6138); 1311-1314. DOI: 10.1126/science.1235547

INTELLECTUAL PROPERTY

Patent application in National Phase (China, Europe, Japan, South Korea, USA)

OPPORTUNITY

Seeking partners for collaboration on future work and the commercialisation of products.

CONTACT

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