



Company: Paragraf

Knowledge Transfer Partnership: Can we use graphene to replace Indium?

Indium is a rare metal and one of the most expensive materials on the market with significant volatility in price. It's in high demand for technology including solar panels, televisions and other electronic products, but its scarcity means we need to look for alternatives. Paragraf, the first company in the world to mass-produce graphene-based electronic devices, wants to see if its product can replace Indium.

Challenge

Indium is on the EU Critical Materials List and is widely used in electronics products around the world. Its main use is in Indium Tin Oxide (ITO), which is found in many consumer electronics. It is a scarce material, and with electronics production showing no signs of slowing, there is a challenge to find a suitable – and cheaper – alternative.

The challenge is to find a sustainable material that has the same properties as ITO. These include high electrical conductivity, high transparency and easy of disposition. And any replacement material needs to be affordable and have predictable future cost to the manufacturer. ITO currently costs five times as much as silver per kilogram.

Graphene is an excellent alternative in principle. But in practice, it has been difficult to scale up production of graphene in the sizes and quantities needed for fast-moving commercial applications.

Process to Solution

The KTP Associate for this project has worked with Paragraf to study and develop

a wide range of graphene devices. Paragraf has already been able to produce graphene at up to eight inches in diameter, using a new process. The KTP built on this work to investigate how this process can be used and improved to produce the required amount and size of graphene without compromising the essential characteristics needed for electronics manufacturing.

A number of companies donated device structures to this project for testing: solar cells, devices used in mobile phones from IQE, and LEDs from Plessey. In addition, Queen Mary has assessed Paragraf graphene as an ITO replacement for organic LEDs (OLEDs), and the UK lighting and display company Forge Europa will perform accelerated reliability tests on the graphene-assisted devices.

Impact

If successful, the ability to replace ITO with graphene will both solve the issue of the scarcity of Indium, and result in lower purchase costs for electronic manufacturers. Graphene is a sustainable, stable material, and the results of this study

could have wide-reaching impacts on the use of graphene in other contexts.

The application seeks to show that not only can graphene replace indium as part of the OLED but can also be used in the fabrication of the control electronics for each pixel, further simplifying the manufacturing process.



Graphene is an extraordinary material that offers incredible potential in the world of electronics, not least in the replacement of expensive, extremely environmentally unfriendly device contact layers. This exciting project between Queen Mary and Paragraf has the opportunity to revolutionise the industry and provide a safer, more cost-effective, renewable solution for electronics."



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