Is graphene the best quantum resistance standard?

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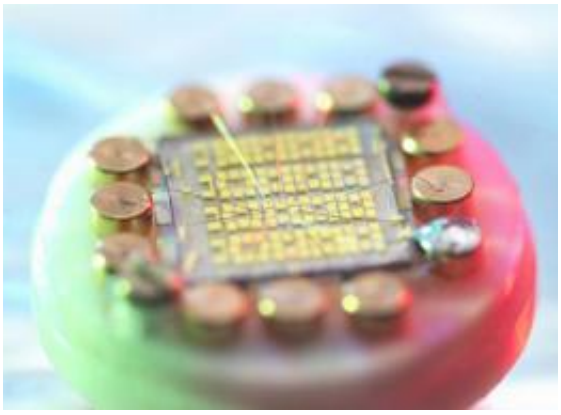

Graphene has the potential to surpass conventional materials in many applications including quantum resistance metrology

New research from NPL's Quantum Detection Group presents the most precise measurements of the quantum Hall effect ever made, using the two-dimensional material graphene.

The quantum Hall effect defines a relationship between two fundamental physical constants: the Planck constant h and electron charge e. It is vitally important for a 'quantum-based' redefinition of the SI units of mass (kilogram) and current (ampere) based on these constants. Experiments are needed to test the quantum Hall effect in different materials in order to prove whether or not it is truly universal.

This research compared the quantum Hall effect in graphene with that observed in a traditional semiconductor material. Graphene is hotly tipped to surpass conventional materials in many important applications, partly due to its extraordinary electrical properties.

The results confirmed that the quantum Hall effect is truly universal with an uncertainty level of several parts in 1011, supporting the redefinition of the kilogram and ampere. They also suggest that graphene should be the material of choice for quantum resistance metrology.

JT Janssen, NPL Science Fellow and author of the research, said:

"Many metrology laboratories around the world have been striving to do this experiment and it is a real achievement that the NPL team and its co-workers were the first to get this key result. It turns out that the quantum Hall effect in graphene is very robust and easy to measure - not bad for a material that was only discovered 6 years ago."

The research was conducted in collaboration with the Bureau International des Poids et Mesures, Chalmers University of Technology (Sweden), Lancaster University (UK) and Linköping University (Sweden).

More information: Read the full paper.

Provided by NPL