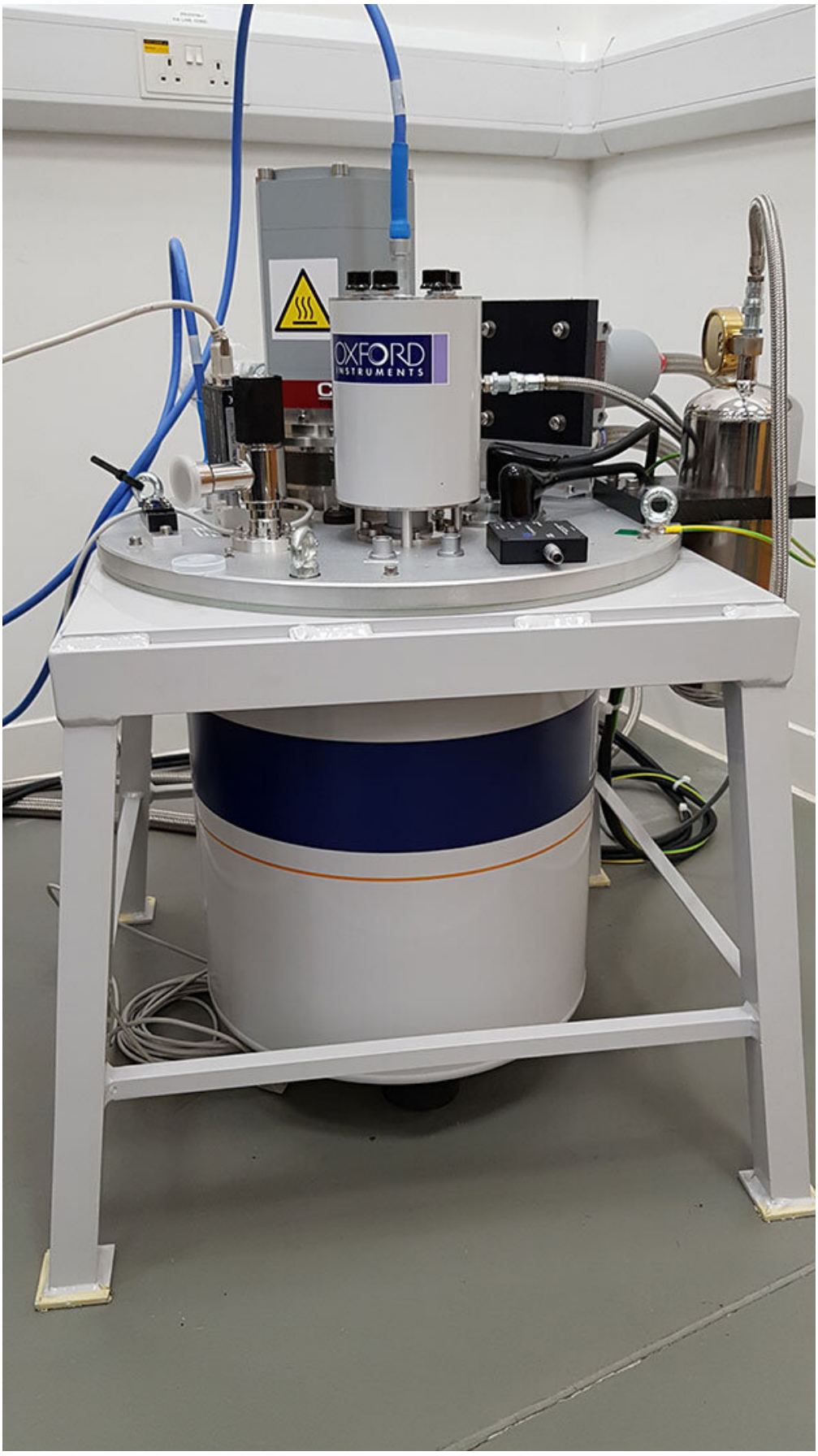
Graphene paves the way for novel product enabling industrial users

August 13 2019


OXFORD
INSTRUMENTS

Credit: National Physical Laboratory

NPL, Chalmers University of Technology and Graphensic, have demonstrated the long-term stability of the epigraphene quantum Hall chip, which represents a key step towards enabling end-users to maintain their own resistance standards

The SI unit of resistance is realized at NPL using a quantum Hall effect device. Recent research on graphene devices has enabled the quantum Hall effect to be realized at both lower magnetic fields and higher temperatures, whilst still retaining part per billion accuracies. The detailed findings are published in a recent edition of *Metrologia*.

NPL in collaboration with Oxford Instruments is developing a table-top primary standard of resistance incorporating both a graphene quantum Hall effect device and a cryogenic current comparator in the same cryostat, in order to provide a compact and easy-to-operate system for metrology laboratories.

The long-term collaboration between NPL, Chalmers University of Technology and Graphensic, has resulted in a big advance in graphene samples. Epitaxial graphene (epigraphene) has been grown on silicon carbide and has better performance at higher temperatures and lower magnetic field than was previously possible. In practical terms, it has also removed the difficult process of fine-tuning the carrier density and means the 'table-top' system can be warmed up and cooled back down and the plateau stays where it is set with no user intervention.

NPL, Chalmers University of Technology and the national metrology

institute of Sweden (RISE) have demonstrated the metrological quality and stability of these types of devices for up to two years.

JT Jansen from NPL explains the importance of this work: "One of the aspirations of quantum metrology is to deliver primary standards directly to end-users. Epitaxial graphene has enabled us to demonstrate significantly shorter traceability chains and more accurate measurements , with a more accurate and compact piece of equipment. This is a step change in capability and an exciting development."

Sergey Kubatkin from Chalmers University of Technology explains more: "With the new definitions of certain units within the International System of Units (SI) coming into effect since May 20th 2019, the epigraphene-based quantum Hall devices are used to disseminate not only the electrical units, but also other standards relying on electrical measurements, such as the unit of mass, the kilogram."

Amer Ali, CEO at Graphensic sums up the development: "We've faced some serious challenges in every aspect of making these devices to get to the level we are at today, being able to offer commercial devices for products operating in real-life applications."

Ziad Melhem, Strategic Business Development Manager of Oxford Instruments NanoScience said: "This is an exciting achievement by the partners in demonstrating the successful use of graphene material to enable new innovative and turnkey commercial solution in a compact and table-top quantum standard measurement system for resistance."

More information: Hans He et al. Polymer-encapsulated molecular doped epigraphene for quantum resistance metrology, *Metrologia* (2019). DOI: 10.1088/1681-7575/ab2807

Provided by National Physical Laboratory