Archer Materials
Technology

Archer Materials Limited (ACN: 123 993 233)
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ASX Announcement (ASX: **AXE**) 30 October 2024

Archer improves the functionality of its ^{12}CQ quantum project with international partners

Highlights

- Archer Materials has co-developed a new device design with researchers at Queen Mary University of London ("QMUL"), that uses graphene to make electrical contact with carbon nanosphere ("CNS") spin material.
- Clear signature of "Coulomb Blockade" (the precise control of a small number of electrons on a quantum dot) has been observed at room temperature.
- Archer has measured electron spin lifetimes on picolitre volumes of its spin materials using its integrated-circuit-based pulsed Electron Spin Resonance ("p-ESR") chip with École Polytechnique Fédérale de Lausanne ("EPFL").
- Archer has identified new potential applications for its novel carbon film material and is exploring development opportunities.

Archer Materials Limited ("Archer", the "Company", "ASX: AXE"), a semiconductor company advancing the quantum technology and medical diagnostics industries, has achieved some key milestones in its research undertaken in collaboration with two of its international research partners. These achievements include room temperature observation of "Coulomb Blockade", and chip-based spin detection of Archer's novel carbon spin materials, two key milestones for the development of the ^{12}CQ quantum project.

New device architecture achieves "Coulomb Blockade" phenomenon

Archer has developed a new device architecture and fabrication process in partnership with researchers at QMUL, which includes the use of graphene to make electrical contact to Archer's CNS spin materials. The architecture of the new device design leverages Archers existing research, realised in the development of Archer's graphene Biochip.

In early-stage testing, Archer has electrically contacted single CNSs or, in some cases, chains of 2-3 using nanoscale patterned graphene contacts. This allows observation of key quantum electrical behaviour.

Room temperature testing and characterisation measurement of the graphene electrode device revealed a clear signature of "Coulomb Blockade". Coulomb Blockade is the inhibition of electron tunnelling in quantum dots, which means that the team has a precise control of a small number of electrons on a quantum dot. The onset of this quantum behaviour is a significant milestone for Archer as it demonstrates the potential for room temperature operation of the ^{12}CQ quantum devices. The team has also been able to accurately characterise the fundamental and electrical properties of this new device design (see Image 1) with electrical measurements performed at 80 degrees Kelvin (-193.15C).

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Next steps with QMUL include electrical testing at millikelvin temperature (below -272C). This will provide a much more detailed understanding of the electrical properties and quantum behaviour of these devices, which is necessary for optimising the performance and accuracy, particularly in regard to quantum readout (the output of information from the chip).

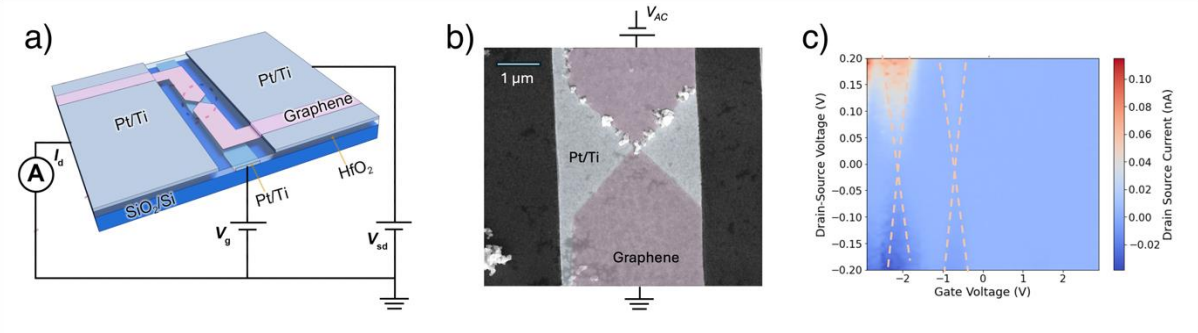

Image 1. a) Schematic of Archer's newly developed quantum device design, which integrates graphene to make electrical contact to the CNS materials, and the corresponding electrical circuit. **b)** A close-up region, defined in the red dashed circle in figure a), showing the CNS material positioned over the graphene contacts. **c)** Demonstration of the electrical measurements performed at 80 degrees Kelvin shown clear signature of "Coulomb Blockade". The new device design leverages Archer's existing expertise, gained in the development of Archer's graphene Biochip, and developed in partnership with researchers at QMUL.

Progress in key measurements for readout capability

In the ongoing partnership with EPFL in Switzerland, Archer has also achieved an important milestone in using its recently developed p-ESR chip (see announcement 25 March 2024) to accurately readout the quantum coherence spin lifetime of very small pieces of Archer's spin materials (picolitre volumes). This includes the novel carbon film, highlighted in a recent announcement (see announcement from 30 September 2024), as well as previous generations of Archer's CNS spin materials. The spin coherence lifetime of the film was measured at 380 ns and the CNS was 160 ns.

Both the very long spin coherence lifetime and the large spin density which has been observed in Archer's novel carbon film spin materials, as well as enhancing the performance of the quantum computing chip, opens the possibility of additional quantum applications for the Company's ^{12}CQ project. For example, in the area of imaging, sensing, communication, and navigation.

Commenting on the ^{12}CQ developments, Greg English, Executive Chair of Archer, said,

"The ^{12}CQ project continues to make significant steps towards better performance, including controlling electrons and demonstrating readout, which are both important in the development of the quantum computing chip. The improvement of room temperature operation and quantum coherence electron spin lifetimes also help bolster functionality of the chip.

"The work being done by the team and its research partners means that Archer can possibly extend the ^{12}CQ project beyond quantum computing and into imaging, sensing, communication, and navigation."

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The Board of Archer authorised this announcement to be given to ASX.

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About Archer

Archer is a technology company that operates within the semiconductor industry. The Company is developing advanced semiconductor devices, including chips relevant to quantum computing and medical diagnostics. Archer utilises its global partnerships to develop these technologies for potential deployment and use across multiple industries. www.archerx.com.au