

ASX Announcement ([ASX: AXE](#))

22 February 2021

Electronic transport in a single qubit achieved

Highlights

- Archer achieves a key technological milestone in the development of its ¹²CQ quantum computing qubit processor chip technology.
 - The work represents a significant technical achievement because the electronic transport measurements were performed on a single qubit – only a few hundred atoms across – and at room temperature.
 - The Company utilised over \$150 million of semiconductor foundry facilities and some of the most advanced instrumentation in the world to complete its most recent validation of the ¹²CQ technology.
 - Archer is one of only a few players[†] developing a qubit processor chip in the emerging multibillion-dollar quantum computing industry[‡].
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Archer Materials Limited (“Archer”, the “Company”, “[ASX: AXE](#)”) is pleased to announce the Company has achieved electronic transport in a single qubit at room temperature, as part of its ¹²CQ quantum computing qubit processor chip (“¹²CQ chip”) technology development. This achievement is fundamental to the successful development of the ¹²CQ chip.

Archer successfully performed the direct measurement of the room-temperature two-terminal resistance of the qubit material (“qubit”), which is the core component of the ¹²CQ chip (Image 1). Current-voltage traces were repeatedly and reproducibly recorded over various voltage range on single isolated qubits, two-qubits, and qubit clusters. The qubits were advantageously robust and withstood damage or change in electronic structure during measurement.

The outcomes of the measurements provide the necessary quantitative data and component-level information that directly validates the ability of the qubits to operate within the electronic parameters required for functional, gated semiconductor devices at room temperature. This represents a significant commercial advantage over competing qubit chip device proposals.

Commenting on the recent Company achievement, Archer CEO Dr Mohammad Choucair said: “In building our ¹²CQ chip for room temperature operation and integration onboard electronic devices, we are pushing the boundaries of what can be done technologically in the world today. The importance of achieving electronic transport in a single qubit at room temperature cannot be overstated as it will have a positive and broad impact on the development of the ¹²CQ chip.”

“The work unambiguously shows that a single qubit – the fundamental quantum information containing material component of the ¹²CQ chip – could be used to build ‘gated’ semiconductor

[†] <https://www.nature.com/articles/s42254-020-00247-5>; also <https://www.ibm.com/quantum-computing/network/members/>

[‡] <https://www.bcg.com/en-au/publications/2020/how-financial-institutions-can-utilize-quantum-computing>

devices. This is great news and direct technological validation for both the fabrication and operation of the ^{12}CQ chip”.

“Archer is working with the few people and institutions in the world that have the know-how, facilities, and instrumentation to drive our development forward at pace. The greatest amount of value creation in the quantum computing economy is currently generated from technology development like that which has been achieved here.”

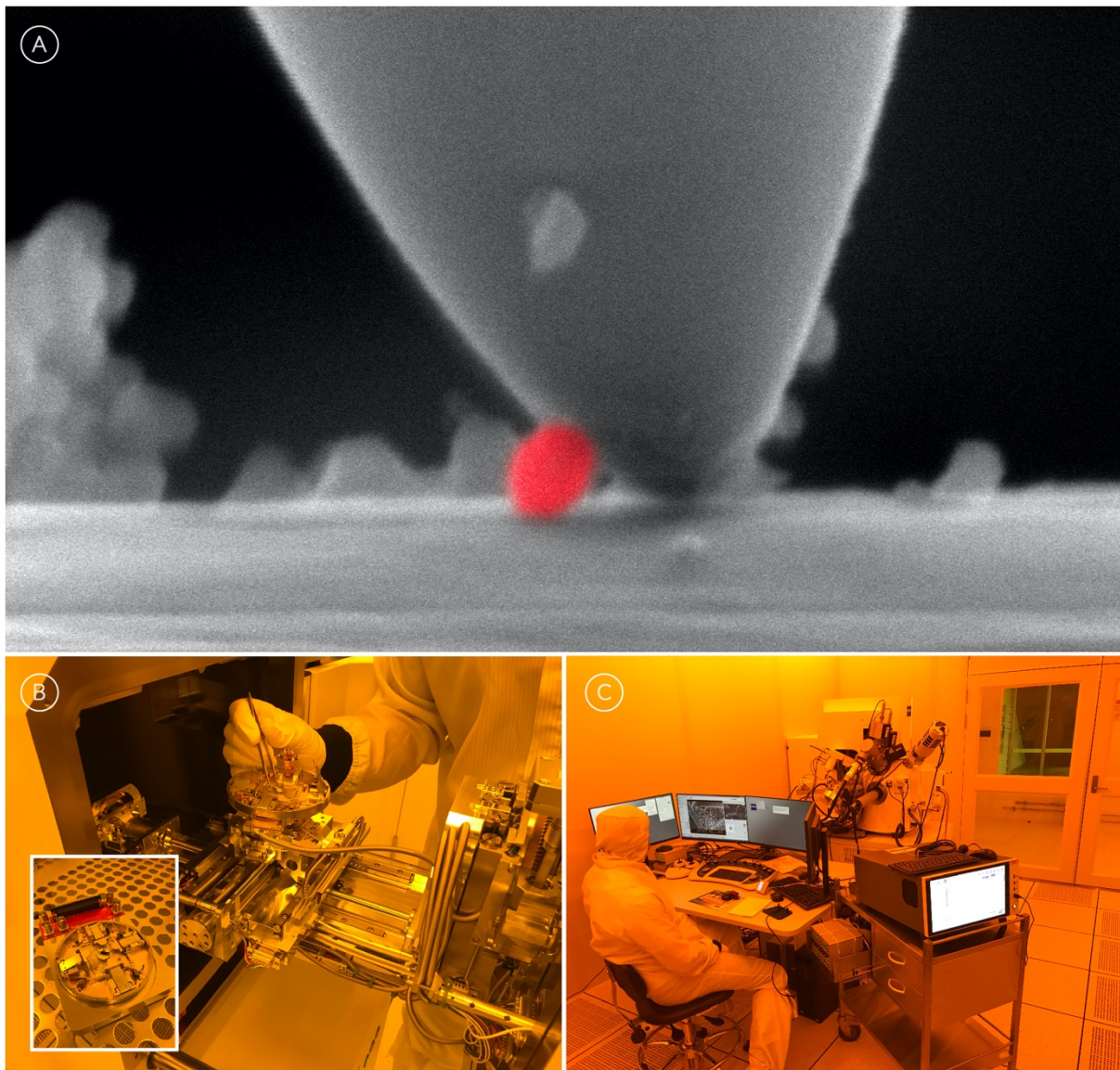


Image 1. Electronic transport measurements of a single qubit. **A** Microscopy image of an individual isolated qubit (identified by false colouring in red) of about 50 nanometers in size (where 1 nanometre is a billionth of a metre) positioned with extreme accuracy between two probe tip surfaces only a few hundred atoms apart, which then serve as electrical contacts to perform the electronic transport measurements. The sophisticated measurement set up, instrumentation, and analysers are shown in **B** with a high-precision tool shown in the *inset* in **B**. The Archer team and collaborators assembled and customised the instrumentation and hardware to address a number of technological challenges in order to successfully perform the measurements at room temperature, which were all carried out in a [research and prototyping semiconductor foundry](#) with a cleanroom environment and sterile protocols, **C**.

The measurement outcomes directly resolve that the qubits are sufficiently similar not only in morphology, but also in their electronic properties, which is essential for their use in a multi-qubit architecture, where each qubit needs to be ‘addressed’ individually in a device. This validates the high quality of each qubit (amongst the trillions and trillions available from bulk quantities) and increases the likelihood of scalable manufacture of Archer’s ¹²CQ chip.

The information obtained from the electronic transport measurements is in excellent agreement with the quantum mechanical theory of the qubit material developed by the Company (ASX ann. [12 October 2020](#)) and the measurement of qubit conductivity (ASX ann. [15 Jun 2020](#)). Furthermore, the work reported in this ASX Announcement verifies claims in the registered Japanese patent (ASX ann. [20 Jan 2021](#)), international patent applications (ASX ann. [6 Oct 2020](#)), and scientific publication[§] underpinning the ¹²CQ chip technology.

This demonstrates that the Company continues to successfully operate under a high degree of scrutiny in its qubit chip development and commercialisation. Archer is currently performing quantum measurements and materials characterisation at different laboratory facilities that form a part of the Company’s technology development work package focused on ‘qubit control’ which continues and is on track with the successful outcomes in this ASX release.

About ¹²CQ

¹²CQ is a world-first qubit processor chip technology that Archer aims to build for quantum computing operation at room-temperature and integration onboard modern electronic devices. For more information, please view Archer’s recent [webinar](#) with IBM.

About Archer

A materials technology company developing innovative deep tech in quantum computing, biotechnology, and reliable energy. The Company has strong intellectual property, world-class in-house expertise, a unique materials inventory, and access to Tier 1 technology development infrastructure.

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

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[§] <https://www.nature.com/articles/ncomms12232>