

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

10 August 2020

Quantum devices successfully built for qubit control

Highlights

- Qubit control devices have been built for quantum control measurements to characterise Archer's unique ¹²CQ qubit processor chip components.
 - Archer and the Company's collaborators rapidly developed qubit control devices 'end-to-end' using in-house expertise and local world-class facilities.
 - Quantum control measurements are a world-first and successful development would be early-stage validation of ¹²CQ chip operation.
 - ¹²CQ chip build is advancing, recently achieving key disruptive early-stage technology milestones in the global quantum computing economy.
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Archer Materials Limited ("Archer", the "Company", "[ASX: AXE](#)") is pleased to announce the Company has successfully built the quantum devices required for initial qubit control measurements as part of a significant phase in its technology development related to the operation of the ¹²CQ room-temperature quantum computing qubit processor ("chip").

Commenting on the Company's ¹²CQ chip development, Archer CEO Dr Mohammad Choucair said: "We commenced our technology development related to qubit control a few weeks ago ([ASX ann. 9 Jul 2020](#)) and now the first devices have been built to perform the initial [qubit control] measurements related to Archer's ¹²CQ chip operation. We have remained on track in our development since we first commenced the [¹²CQ chip] project in April 2019".

"Qubit control is explicitly our next big technological milestone. Over the coming months, Company shareholders will expect to see a series of results that will be released to ASX by Archer that relate to qubit control – a key requirement of quantum computing processors. When successful, the work would be major validation, at a relatively early-stage of the overall development of a quantum computing processor, of the commercial viability of the ¹²CQ chip".

Prototyping qubit control devices and componentry

The Archer team has built and begun testing prototype qubit control devices ("ESR devices") in Sydney with collaborating institutes, Image 1. The initial prototyped ESR device has the primary benefit ("Primary Benefit") of providing the magnetic ultra-sensitivity to establish quantitative measurements (i.e. characterisation) of the quantum information residing on very few qubit material components ("qubits").

The initial ESR device design is intended to allow for qubit control measurements only at low temperatures to maximise the Primary Benefit, with the associated operation temperatures unrelated to Archer's qubits' demonstrated potential to operate at room temperature. The ESR device assembly is unique and unoptimised, subject to changing functional configurations.

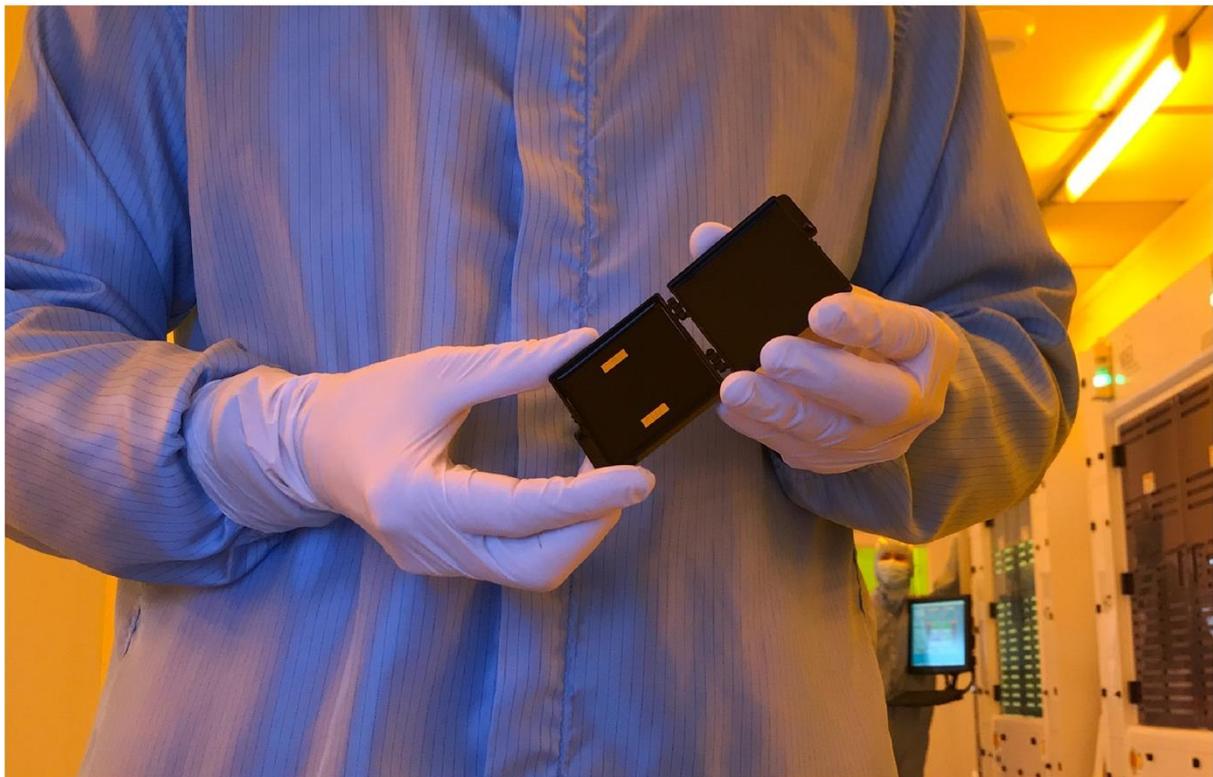
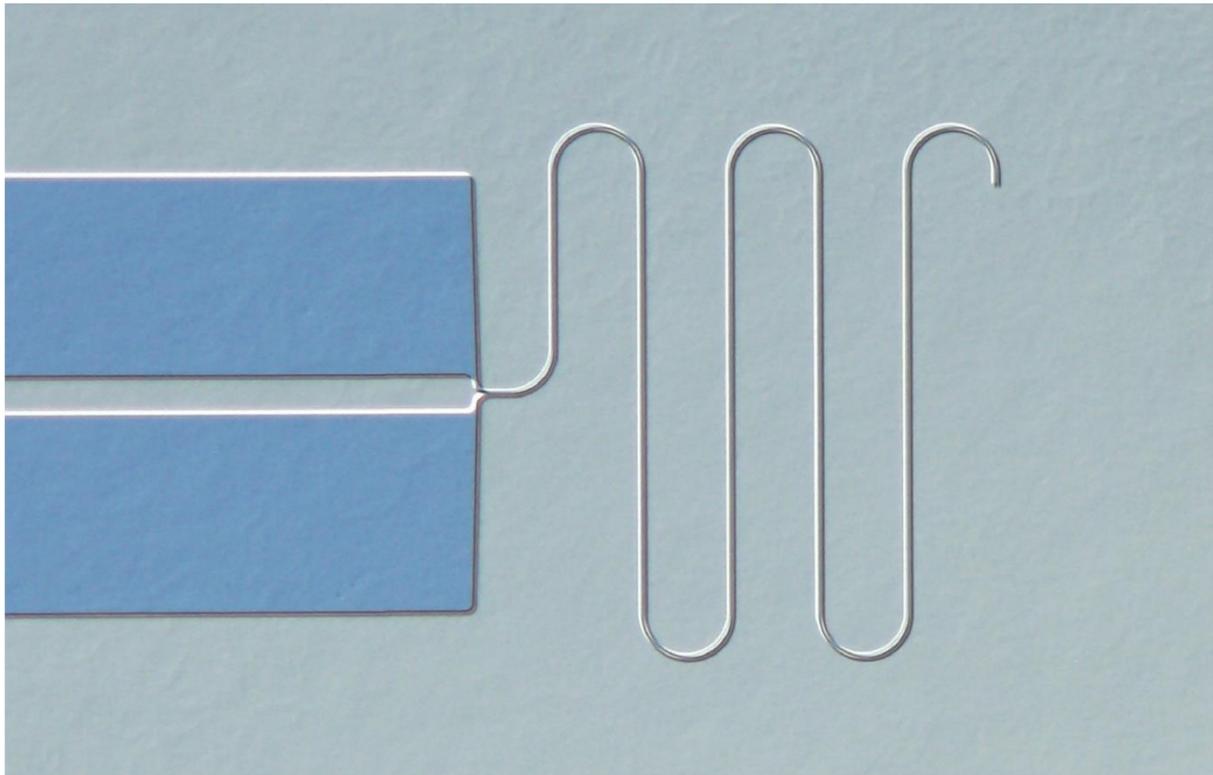


Image 1. Top High-magnification image of part of the prototype nanoscale ESR device. The full ESR device design is commercial-in-confidence. The ESR device has been fundamentally developed end-to-end and custom-built together by Archer and collaborators in Sydney, Australia, including all quantum mechanical theoretical considerations, the materials formulations used, the device operation, function and purpose, and its fabrication and testing. **Bottom** Archer staff holding two fabricated prototype ESR devices (appear a gold colour in a black device carrier), at a semiconductor foundry in Sydney.

Achieving qubit control in few to single qubits represents a major technical milestone

Archer CEO and inventor of the ¹²CQ chip technology, Dr Mohammad Choucair, previously demonstrated coherent control of quantum information [measured] over bulk quantities of qubits at room temperature *i.e.* on aggregates of trillions and trillions of qubits[†]. However, the ¹²CQ chip design requires the isolation of a few to single qubits. Therefore, qubit control must be performed on isolated few to single qubits for successful operation of the ¹²CQ chip.

Qubit control involves componentry fabrication and prototyping of testbed devices (like that reported in this announcement and also see ASX ann. [15 Jun 2020](#)), quantum information control measurements, quantum materials characterisation and ultimately, accessing and processing quantum information residing on individual and few qubits.

Recently, as part of the Company's broader technology development involving quantum measurements (which also includes qubit control), Archer demonstrated the scalable assembly of isolated single qubit arrays (ASX ann. [13 Nov 2019](#)) and then directly measured single qubit conductivity (ASX Ann. [15 Jun 2020](#)) which is credible proof for addressing global quantum computing industry early-stage key success drivers related to scalability and use[‡].

Archer CEO Dr Mohammad Choucair concluded: "The control measurements on the qubit material related to the ¹²CQ chip fabrication are a world-first, in particular for solid-state, non-optical quantum computing systems.

"Archer is at the forefront of a global race to develop a potential solution to commercially viable [qubit processor chip] technology for the widespread use of quantum computing – technology which is at the foundation of an emerging multibillion dollar global industry".

Archer's ¹²CQ chip technology

¹²CQ is a world-first technology that Archer aims to build for quantum computing operation at room-temperature and integration onboard modern electronic devices. For more information about Archer's quantum computing technology, please view the Company's [most recent technical presentation](#).

¹²CQ[®] is a registered trademark of Archer Materials Limited.

Next steps in the ¹²CQ fabrication roadmap

The Company's technology development is currently focused on achieving quantum control of a single qubit, which is essential for quantum information processing. Archer will perform quantum measurements and materials characterisation at different laboratory facilities to achieve quantum control, and key measurements will be released to ASX. The control measurements will be performed in parallel to other technology development work packages, intellectual property prosecution, and commercialisation.

Further reading with much deeper technical details on what is generally and fundamentally involved in [performing quantum measurements on a single qubit](#) is available online.

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

[‡] <https://www.bcg.com/en-au/publications/2019/quantum-computers-create-value-when.aspx>

About Archer

A materials technology company developing materials in quantum computing, biotechnology, and lithium-ion batteries, and exploring for minerals in Australia. The Company has strong intellectual property, broad-scope mineral tenements, world-class in-house expertise, a unique materials inventory, and access to over \$300 million of technology development infrastructure.

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

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