Corporate
Quarterly Report

Archer Materials Limited (ACN: 123 993 233)
Lot Fourteen, Frome Road, Adelaide SA 5000
www.archerx.com.au

ASX Announcement (ASX: **AXE**) 26 April 2022

Third Quarter Activities Report

For the three months ending 31 March 2022

Significant Activities

- The Company is well capitalised with approximately $28.3 million cash and no debt.
- Major technical feat achieved in Archer's ^{12}CQ quantum chip development that supports the possibility of the technology to enable quantum powered mobile devices.
- Archer expands on its ^{12}CQ quantum chip technology patent protection in the US, China, South Korea, and Japan, with a European patent grant providing protection in a further 12 countries including the UK, France, and Germany.
- The Company continued its focus on scaling up its domestic and international capabilities in advanced semiconductor design, fabrication, and prototyping, with access to infrastructure and strategic hires in the quantum computing industry.
- Key nanotech challenges in biochip development overcome with Archer successfully integrating single atom-thick graphene on a silicon wafer, and subsequently filing an Australian provisional patent application.
- The Company was added to The All Ordinaries Index.

Archer Materials Limited ("Archer", the "Company", "ASX: **AXE**") is pleased to report on its activities for the three months ending 31 March 2022 ("Quarter").

Commenting on third quarter activities, Greg English, Executive Chairman of Archer, said, "Our ability to detect quantum information in the 12CQ qubit material, at room temperature, using mobile phone technology (high electron mobility transistor (HEMT)) was a great achievement. The use of the well-established and widely used HEMT technology is consistent with our strategy to make the ^{12}CQ chip compatible with modern electronics."

"The granting of the European patent during the quarter grants Archer much needed protection as we assess our overseas expansion options, including potentially the UK, Netherlands and Switzerland."

"During the quarter we successfully integrated a graphene sheet with silicon electronics which was a significant technical achievement in the development of our 100% owned biosensor. This work fundamentally links to using graphene transistor technology in the future operation of Archer's biochip."

"The easing of COVID restrictions has allowed us to scale up our activities by accessing new overseas labs, facilities and people. A key focus area for Archer's scale up includes the Company's domestic and international capabilities in advanced semiconductor design, fabrication, and prototyping."

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Quarterly Activities to 31 March 2022

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. The Company is progressing the development of its ^{12}CQ quantum computing qubit processor chip ("^{12}CQ chip") and 'lab-on-a-chip' biochip technology ("biochip").

Technology development and commercialisation activities

^{12}CQ Chip

Archer's ^{12}CQ chip is a world-first qubit processor technology the Company is developing that would allow for mobile quantum computing powered devices. The Company for the first time has detected quantum information in the ^{12}CQ qubit material on-chip and at room temperature using mobile phone compatible technology (ASX ann. 1 Feb 2022).

Archer and teams from the world-class institute EPFL (École Polytechnique Fédérale de Lausanne), located in Switzerland, have now used a single-chip integrated electron spin resonance ("ESR") detector based on a high electron mobility transistor ("HEMT") technology to detect and characterise the as-prepared ^{12}CQ qubit material in a controlled atmosphere at room temperature (Image 1).

The signal characteristics obtained agreed with the well-studied, repeatable, and scientifically published results obtained from room temperature measurements performed on macroscopic ('bulk') quantities of the qubit material using continuous wave ESR instruments[1].

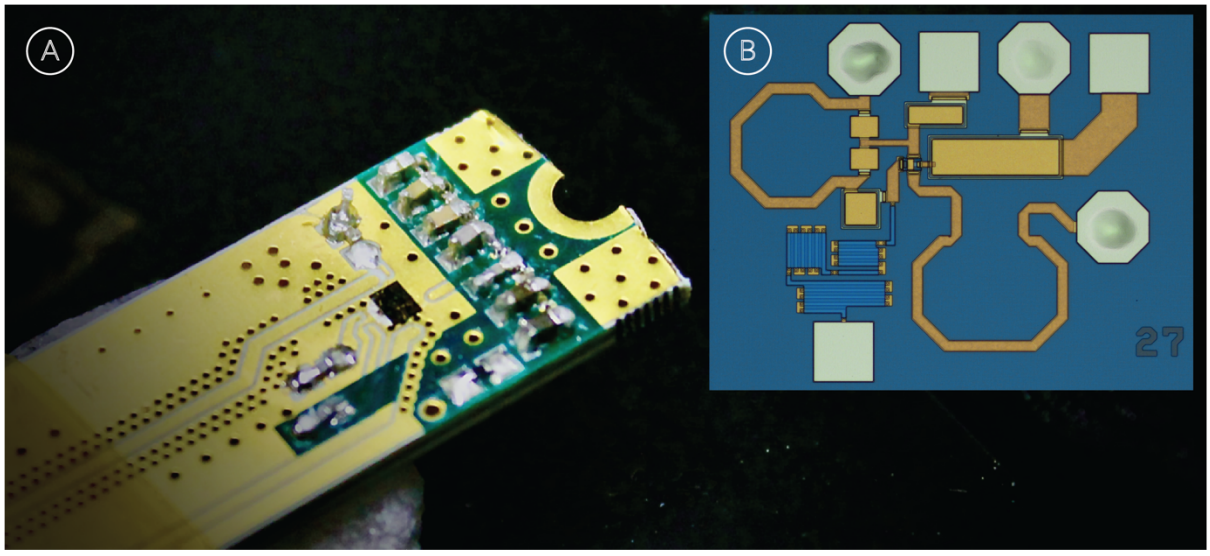

Image 1. A The integrated single chip ESR detector based on HEMT. **B** A microscope image of a region in **A** (inside the black square in the centre of the chip) of approximately 0.5mm x 0.5mm showing the miniaturised on-chip ESR componentry used to detect the quantum spin states in Archer's ^{12}CQ qubit material at room temperature.

[1] https://www.nature.com/articles/ncomms12232

The unoptimised ESR chip devices were of sufficient sensitivity to detect the electron spin in a few picolitres (picolitre is a trillionth of a litre) of qubit material at room temperature. The quantum information in the qubit material is in the form of an electron's 'spin' states. The quantum states were found to be sufficiently well preserved when operating in an on-chip environment.

The single-chip resonator was developed at EPFL, and manufactured by semiconductor company OMMIC using existing foundry processes and facilities, near Paris, France.

HEMT devices are widely used in integrated circuits, for example in mobile phones, and are well-known in the semiconductor industry due to their low power consumption (the HEMT based ESR detector chip device referred to in this Announcement consumed approximately 90 µW of power at room temperature operation).

The HEMT technology was initially utilised for the ESR chip in part to confirm the advantages of low power consumption offered by a HEMT for the qubit measurements, and the chip having simplified integrated electronics to a single transistor.

The coherent control of quantum information in qubit materials is the fundamental requirement for quantum logic operations that are the basis of *any* quantum computing qubit processor hardware. For potential development and use of Archer's qubit materials in practical quantum processor chip devices, it is significant to demonstrate the room temperature detection of quantum information using mobile-compatible device technology.

By demonstrating the detection of electron spin quantum states using a single chip ESR detector based on HEMT, the technology paves the way for the implementation of the complex qubit control characteristics required in quantum circuits.

Further information on Archer's global competitive advantage and tech differentiation

Quantum computing technology is a new way of computing that is distinct from current computing technologies (e.g., silicon-based transistor and memory chips including CPUs, GPUs, Flash/DRAM, 'neuromorphic' processors etc.). A qubit processor ("Quantum Chip") is the most crucial hardware component of a quantum computer. Quantum Chips come in a variety of forms depending on the qubit type and materials used (in contrast to the modern computing industry dominated by silicon/semiconductors).

Many quantum computing proposals currently use Quantum Chips that require materials and qubits which operate at low temperatures and/or are difficult to integrate in modern electronics, which limits ownership and use of practical quantum devices.

The scientific breakthrough made in 2016 to realise Archer's ^{12}CQ qubit material is available online in the peer-reviewed scientific journal Nature Communications[1], which reports the advantages, technological trade-offs, and the technological barriers that have been overcome towards realising practical quantum computing, over several other qubit proposals (e.g. nitrogen-vacancy centre nanodiamonds, isotopically enriched fullerenes, quantum dots, molecular magnets, phosphorous in silicon, fullerenes, nanomagnets, superconductors, etc.).

Some of the advantages of Archer's ^{12}CQ chip qubit material include the combination of the potential use for room temperature quantum computing *and* integration with electronic devices. Archer's technology development advances continue to provide direct evidence to support this exciting possibility.

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During the Quarter, Archer expanded on its ^{12}CQ chip technology patent protection in the US, China, South Korea, and Japan, with a European patent grant providing protection in a further 12 countries including the UK, France, and Germany, (Exhibit 1) (ASX ann. 23 Feb 2022).

The granting of the European Patent[2] (Patent No. 3383792) represents a significant early-stage milestone in Archer's development of the ^{12}CQ chip. The countries in which the European Patent is to have effect ("the Jurisdictions") are Belgium, Switzerland & Liechtenstein, Germany, Spain, France, the United Kingdom, Italy, Turkey, the Netherlands, Sweden, and Ireland.

Exhibit 1. Description of Archer's technology patents and patent applications

Filing Date	Technology Summary	Stage & Coverage	Patent/Application Number
3 Dec 2015	■ **A quantum electronic device.** Quantum electronic devices for processing qubits represented by an electron spin on a new type of carbon nanomaterial and methods for using this material in quantum computing.	**Granted**	
		Japan	6809670
		South Korea	10-2288974
		China	4606612
		United States of America	11126925
		Europe	3383792
		Pending	
		Australia	2016363118
		Hong Kong	18115770.4
15 Feb 2019	■ **Graphene complexes and compositions thereof.** Complexes comprising graphene compositions, methods of synthesising these complexes and compositions, and the use of these complexes and compositions in biomolecular sensing.	**Pending**	
		Australia	2020220236
		United States of America	17429442
1 Dec 2021	■ **Detection and quantification of nucleic acids.**	**Provisional Patent**	
		Australia	2021903898
31 Mar 2022	■ **Fabrication and processing of graphene electronic devices on silicon with a SiO2 passivation layer.**	**Provisional Patent**	
		Australia	2022900845

Patent Family
■ ^{12}CQ chip ■ Biochip

[2]The European Patent Office provides a single patent grant procedure. A patent granted by the EPO is not a single or unitary European Union patent or uniformly recognised Europe-wide patent, but one or several national patents.

The Company considers the Jurisdictions as critical strategic markets to protect and potentially commercialise its IP. European Patent protection is required for any possible future commercialisation operations in the Jurisdictions, and also provides Archer with access to Europe's largest economies to exploit IP rights related to the ^{12}CQ chip.

During the Quarter, the Company continued its focus on scaling up its domestic and international capabilities in advanced semiconductor design, fabrication, and prototyping (ASX ann. 15 Mar 2022). This included access to infrastructure and facilities, and also the recruitment of talent in the quantum computing industry to grow the Archer team.

The Company has proceeded to gain access to the Australian Nanofabrication Facility UNSW Sydney node. This infrastructure and facilities provides Archer access to multi-million dollar instruments such as the specialised RAITH150 Two Electron-beam Writer which is designed to help with Archer's transition from single-device-oriented R&D towards small-batch high-resolution fabrication of nanodevice prototyping. This access expands on Archer's operation within the Research and Prototyping Foundry in Sydney.

Archer continued its recruitment drive into 2022. Archer has been approved by the Australian Department of Home Affairs as a standard business sponsor, which now broadens the scope of potential talent the Company could pursue by allowing the Company to sponsor international workers.

The Company received over 650 applications for advertised STEM roles that include Quantum Hardware Engineers, Materials Chemists, and Nanofabrication Engineers. Exceptional candidates will be joining Archer over the coming months to execute on the Company's technology development plans. An example of the world-leading experts joining Archer in technology leadership roles to develop the ^{12}CQ quantum computing chip includes Associate Professor Dr. Matthew Broome (Image 2).

Image 2. Archer's Quantum Technology Manager, Dr Martin Fuechsle (left), together with new team member Associate Professor Dr. Matthew Broome (right), while visiting the Company's collaborators at the Swiss tech institute EPFL earlier this year.

A/Prof. Broome joins Archer with over 15 years' experience in building quantum computers, recently moving to Archer from the University of Warwick, UK, where he led a research team designing and fabricating next generation semiconductor devices for a range of quantum applications. In 2017 he was awarded the prestigious Marie Curie Fellowship which he undertook at the world-class Niels Bohr Institute, Copenhagen, where he regularly set international benchmarks in multi-qubit devices.

Between 2014-16, Matthew was a lead researcher at CQC^{2}T at UNSW Sydney, where he fabricated and measured the world's first two-qubit device in a donor-based silicon quantum processor. He completed his PhD at the University of Queensland, Brisbane, in 2013. His thought leadership in the field of quantum computing is evident with over 30 high-impact peer reviewed scientific publications. His outstanding work in quantum computing and technology has been recognised internationally through funding by several organisations including The Royal Society, European Research Council, De Beers, and the UK Defence force.

With the recent progress made by the Archer team in qubit control (ASX ann. 1 Feb 2022), graphene integration with silicon electronics (ASX ann. 13 Jan 2022), and talent recruitment (ASX ann. 15 Mar 2022), the Company has commenced the broadening of its technology development to include other areas that are integral to the ^{12}CQ chip operation. These areas include qubit optimisation and quantum electronic device fabrication. This work can now be performed in parallel to the Company's focus on qubit control.

Archer's Biochip

Archer's biochip is a unique graphene-based technology that the Company is developing to enable the complex detection of some of the world's most deadly communicable diseases. Archer is currently focused on micro- and nano-fabrication of the biochip device components and combining these components with biologically relevant reactions to detect diseases.

During the Quarter, Archer addressed key nanotech challenges in its biochip development by successfully integrating single atom-thick graphene on a silicon wafer and then measuring and confirming the electronic transport properties in the resulting integrated devices (ASX ann. 13 Jan 2022 and 31 Mar 2022) (Image 3).

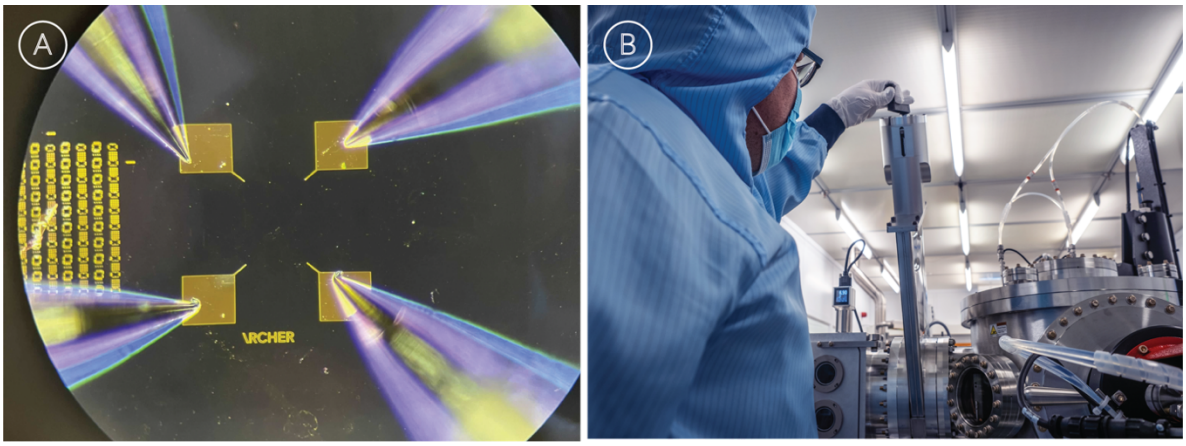

Image 3. A Magnified view of an isolated graphene device undergoing direct measurement of electron transport. **B** Graphene devices are fabricated and tested by Archer staff using highly specialised chip instrumentation in a semiconductor prototyping foundry.

The biochip requires graphene materials in electronic circuits (i.e. the micro- and nanofabrication of graphene-based transistors), that would form miniaturised devices that act as ultrasensitive sensors for detecting and analysing biochemical targets, for example, to identify viruses or bacteria.

The work represents a significant technical achievement as the advanced, post-integration semiconductor fabrication processes are complex, requiring the precision engineering of atomically thin graphene and devices to confirm the advantageous materials' properties, which are fundamental to the scalability, functionality, and operation of Archer's biochip.

The outcomes of the electronic transport measurements provide the necessary data and component level validation of the electronic parameters required to build graphene-based transistors integrated with silicon electronics.

During the Quarter, Archer researchers gained access to additional advanced instrumentation for bioanalysis at Westmead Institute of Medical Research and are preparing for automated testing across other genomic analysis facilities in Sydney as part of the biochip development. Automated testing will provide the Company with efficiency in its 'big data' collection, and complements the Company's access to the Protein Production Facilities in Sydney.

Archer owns 100% of the biochip technology intellectual property. During the Quarter the Company filed an Australian provisional patent application (No. 2022900845) related to its biochip technology (Exhibit 1).

Financial update

The Company's cash balance at the end of the Quarter was $28,366,000.

The Company holds 6,535,775 shares in Canadian Stock Exchange listed Volatus Capital Corp (CSE:VC) and 11,571,119 shares in ASX listed ChemX Materials Ltd (ASX:CMX).

Archer's accompanying Appendix 5B (Quarterly Cashflow Report) includes amounts in item 6.1, which were executive and non-executive director fees paid as salaries and wages. The Company does not hold any mineral tenements and did not spend any funds on exploration activities.

Corporate

The Company was added to The All Ordinaries Index effective before the opening of trading on March 2021, 2022 (ASX ann. 4 Mar 2022).

Issued Capital

Date	Shares	Options
Start of Quarter	247,567,207	35,750,000
New issues during Quarter	Nil	Nil
Options Exercised/forfeited during Quarter	Nil	Nil
End of Quarter	247,567,207	35,750,000
Date of this Report	247,867,207(1)	35,450,000(1)

(1) The exercise of 300,000 unlisted options, exercisable at $0.1511 by 31 March 2023.

Stakeholder events and outreach

Archer has recently been, and is actively and regularly pursuing exposure to global industry participants in the markets relevant to quantum computing and lab-on-a-chip biochip technology, to potentially foster connections with future partners, including at significant industry specific events that help inform Archer's tech development.

During the Quarter, Archer staff attended the Quantum Australia conference in Sydney, in February 2022, which included over 800 participants and 100+ quantum experts, including the Chief Scientist of Australia, and Archer's collaborators from IBM and the global IBM Quantum Network. Archer also joined the NSW Health Cicada MedTech commercialisation program and enrolled in the American Chamber of Commerce Global Leadership Academy.

The Company maintains recent and ongoing participation and contributions in informing the development of Australia's National Quantum Strategy. The strategy development, and such roundtables, are led by Australia's Chief Scientist Dr Cathy Foley. Archer staff also participated as panellists in the South Australian Forum on the Industrial Application of Quantum, led by Australia's Chief Scientist, and South Australia's Chief Scientist.

The Company electronically distributed a number of Newsletters and Commentary to shareholders during the Quarter, including:

- CEO Commentary: A business leader's guide to quantum technology
- Newsletter: Graphene integrated with silicon electronics
- CEO Commentary: Quantum computing governance principles
- Newsletter: Towards quantum powered mobile devices
- CEO Commentary: The realist's guide to quantum technology and national security
- Newsletter: Recruitment, quantum devices, and a European patent

About Archer

Archer is a technology company that operates within the semiconductor industry. The Company is developing and commercialising advanced semiconductor devices, including chips relevant to quantum computing and medical diagnostics.

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

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