Archer Materials Technology

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

Archer develops new manufacturable carbon material and deepens understanding of quantum spin behaviour

Highlights

- Developed new carbon films with electron spin lifetimes exceeding those previously measured on carbon nano-onions.
- The films are produced with a proprietary chemical vapour deposition process. The process should be scalable to full wafers.
- The films can be processed into quantum devices using standard semiconductor fabrication techniques, overcoming the manufacturing roadblock for carbon nano-onions.
- In addition to electron spin lifetime measurements, testing is in progress to observe other key quantum properties required to build quantum devices. We expect to accelerate this compared with our efforts on CNOs.
- The electron spin properties combined with the manufacturability opens a path to using the carbon material in a wide variety of applications like extremely sensitive magnetometers or in the biotechnology field, in addition to quantum computing.
- Experimental work and theory collaboration with EPFL has resulted in further fundamental understanding of our carbon materials. A scientific paper of the findings will be submitted for review and publication in the coming weeks.

Archer Materials Limited ("Archer", the "Company", "ASX: AXE"), a semiconductor company advancing the quantum technology and medical diagnostics industries, has developed a highly manufacturable carbon film with attractive quantum properties including long room-temperature electron spin lifetimes.

The development was made by the quantum team in its ongoing work on creating a scale-up path for carbon nano-onions ("CNOs") and developing manufacturable methods for producing CNOs (ASX announcement 3 September 2024). Archer is expected to be able to observe key quantum phenomena on the films sooner than with CNOs and eventually develop quantum devices more rapidly.

The films are deposited on substrates using a proprietary chemical vapour deposition process, showing lifetimes approaching 400ns, and work continues to improve repeatability and uniformity across wafers. The process is extremely clean, ensuring films have extremely low or controlled levels of impurities and contaminants. This is important for creating long spin lifetimes.

Initial characterisation via electron microscopy shows some short-range order in the carbon films as opposed to atoms being randomly positioned. This has some similarities with the structure of the CNOs and may be part of the explanation for the films to exhibit longer electron spin lifetimes.

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Work is in progress to understand the key parameters that impact spin lifetime so that the material can be further tuned for quantum performance.

The team has continued collaboration with École Polytechnique Fédérale de Lausanne ("EPFL") to gain a fundamental understanding of spin lifetime control in our CNOs. This is a theory-led activity at EPFL with experimental work happening at Archer in Sydney. A scientific paper is in preparation and will be submitted for review and subsequent publishing soon. The work is being extended to the carbon films also.

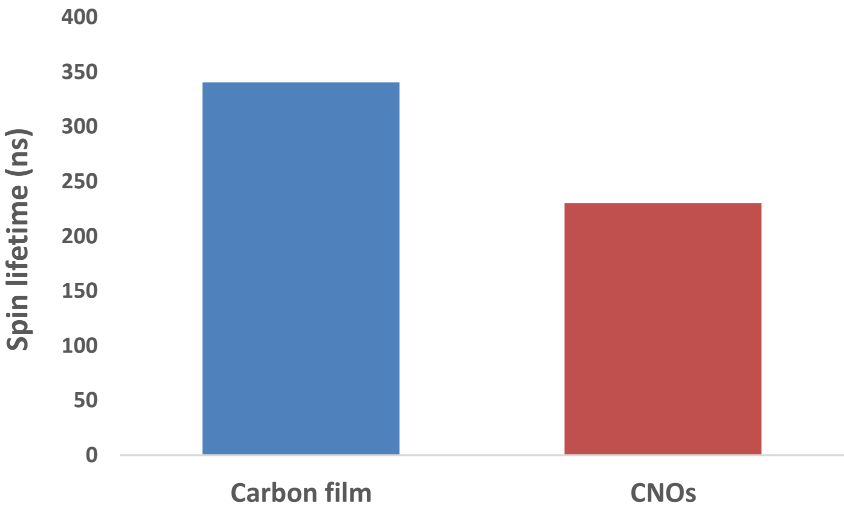
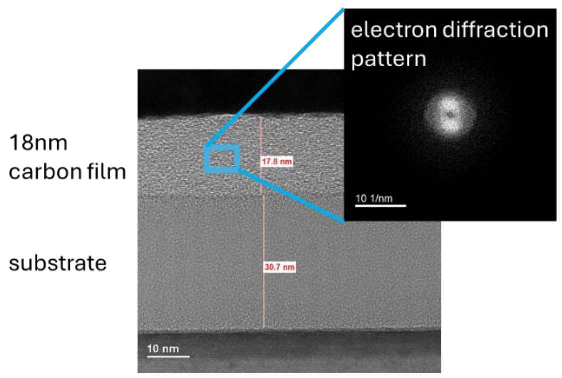
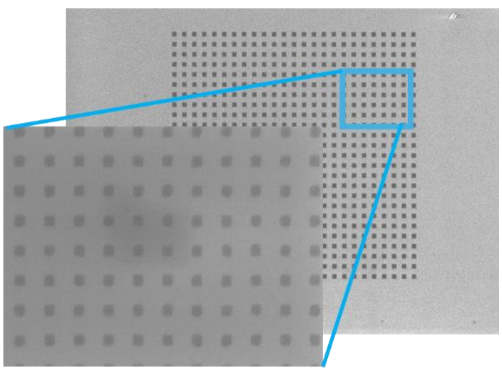


Chart showing spin lifetime on initial carbon films compared with optimised CNOs.

The team can process the films using standard semiconducting processing in contrast with the previous methods required to build devices around CNOs. Characterisation and measurements on the quantum devices can be done faster than those on CNOs. This carbon will be tested alongside CNOs (with our superconducting resonator circuits).



Cross-section (electron microscopy)



Electron microscopy of nanoscale islands of the carbon film.

Left image shows a cross-section of a carbon film that has been grown on a silicon substrate. The right image shows a film that has been patterned into an ordered array of nanoscale islands. Devices can then be fabricated around these islands using conventional semiconductor fabrication processes. Such a structure could be the basis for scaling qubits or building a sensing array on chip. We have been working to achieve the same with CNOs but have not been successful to date.

Commenting on the carbon film development, Greg English, Executive Chair of Archer, said,

"Manufacturability of many quantum materials is an ongoing challenge in the field, as this can also hinder research and development. This new carbon film helps accelerate the manufacturability of the qubit material.

"Working on this new film, alongside CNOs or even in place of CNOs, will accelerate development of our quantum technology and provides a means of volume manufacturing of such devices. By observing quantum phenomena sooner, we can eventually develop quantum devices more rapidly."

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