

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

8 June 2023

Archer achieves major coherence time milestone at room temperature for its qubit material

Highlights

- Archer Materials has advanced the room temperature capabilities of its qubit material, achieving unprecedented quantum coherence times.
 - The long coherence times increases the time-window for processing quantum information at room temperature beyond that for any known, similar qubit materials.
 - This milestone, which was previously only achieved at -173°C, means more complex computing applications could potentially be performed in more normal operating environments.
 - Archer is the only ASX listed company and one of a few players in the world developing qubit processor technology.
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Archer Materials Limited (“Archer”, the “Company”, “[ASX: AXE](#)”), a semiconductor company that advances the quantum computing and medical diagnostics industries, has reached a significant milestone in the room temperature functionality of its cutting-edge qubit material.

Earlier this year, Archer announced that it had made advances in optimising and validating the ¹²CQ qubit material coherence times (ASX ann. Mar 16, 2023). The Archer team prepared and characterised the coherence properties of over 150 separately synthesised qubit material batches. As a result of this work, the Archer team has engineered the quantum properties of its unique qubit material to achieve electron spin coherence times exceeding 230 nanoseconds at room temperature¹ while maintaining the intrinsic metallic-like character of the qubit material. This was achieved by making the qubit material using a different precursor and applying post-synthesis treatments.

Archer believes that no other similar nanomaterial has been shown to achieve such long-lived electron spin coherence at room temperature².

The long room temperature quantum coherence times had previously³ only been achieved for the qubit material at extremely low temperatures of approximately -173°C. In the context of qubit processor development, the increase in quantum coherence time at room temperature is significant.

By extending quantum coherence times, qubit materials can maintain stable quantum states for longer durations, providing a solid foundation for executing more sophisticated quantum algorithms and achieving reliable quantum computations.

¹ At 21.85°C. The quantum coherence measurement was performed with the qubit material sample under vacuum.

² Origin of metallic-like behavior in disordered carbon nano-onions. Carbon, Vol 208, May 2023, Pages 303-310 (<https://www.sciencedirect.com/science/article/pii/S0008622323002166>)

³ Room temperature manipulation of long lifetime spins in metallic-like carbon nanospheres. Nature Communications, Vol 7, July 2016, Article 12232 (<https://www.nature.com/articles/ncomms12232>)

Archer increased its qubit material room temperature capabilities by over 30%, meaning it can now routinely prepare qubit material maintaining quantum superposition states for over 30% longer than previously achieved at room temperature³.

Commenting on the spin coherence milestone, Dr Mohammad Choucair, CEO of Archer, said,

“This achievement is a breakthrough for Archer’s qubit development. Long quantum coherence times are crucial for qubit materials in quantum computing.

“Archer has now demonstrated a significant advance in its qubit materials’ quantum coherence times observed at room temperature. This extended time window for processing quantum information was only previously possible by cooling the qubit material using liquid nitrogen, to reach nearly -173°C.

“Archer is confident that this breakthrough in quantum materials positions it as a leading player in the quantum computing industry, paving the way for the potential development of commercially viable quantum technology solutions.”

This milestone links to the future operation of Archer’s ¹²CQ chip, as the number of quantum control pulses performed in a quantum algorithm is directly related to the quantum coherence time. The development potentially broadens the application space for Archer’s qubit material that would be suited to more normal operating environments, rather than needing to be conducted at extremely low operating temperatures, bringing the technology closer to commercialisation.

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.