Archer Materials Limited (ACN: 123 993 233)
Lot Fourteen, Frome Road, Adelaide SA 5000

ASX Announcement (ASX: **AXE**) 24 October 2022

Wettable graphene transistor built for biochip integration

Highlights

- Major biochip development goal achieved with the fabrication of a graphene-based field effect transistor that operates in a liquid environment.
- The gFET device is the biochip sensing component that will be used for digitising biologically relevant signals, like those from viruses or bacteria.
- Archer's biochip innovation aims to integrate gFETs into advanced microfluidic systems to create miniaturised lab-on-a-chip device platforms.
- The biochip is being developed in-house by Archer staff and Archer owns 100% of the biochip technology intellectual property.

Archer Materials Limited ("Archer", the "Company", "ASX: **AXE**") is pleased to inform shareholders that the Company has achieved a long-term biochip technology development goal to fabricate an operational liquid-gated graphene field effect transistor ("gFET").

Archer's biochip innovation aims to integrate gFETs into advanced microfluidic systems to create miniaturised lab-on-a-chip device platforms for medical diagnostics. In particular, the integration of gFETs with on-chip microfluidics to potentially enable multiplexing, *i.e.*, the ability to parallelise the detection of multiple biologically relevant targets in droplet-size liquid samples on a chip. gFETs offer an ultrasensitive approach to analyte detection over conventional electronic sensors used in current lab-on-a-chip devices[†].

Archer has made significant technological progress over the last year that fundamentally link to using graphene transistors in lab-on-a-chip technology:

+ advanced lithography was used to integrate a single-atom-thick sheet of graphene in silicon electronics
+ hair-thin microfluidic channels were fabricated on a silicon wafer for sample processing and transportation to smaller built-in sensors for analysing biochemical targets
+ biochemical reactions developed with the potential for on-chip detection and quantification of specific DNA or RNA fragments relevant to viruses and bacteria
+ foundry fabricated a magnitude of component feature sizes reaching sub-10nm on a silicon wafer that would potentially allow for high performance sensing
+ designed and fabricated an operational liquid-gated graphene field effect transistor for biochip integration

The gFET device is the sensing component that will be used for digitising biologically relevant signals, like those from target analytes of viruses or bacteria, and it is a foundational feature of Archer's 'lab-on-a-chip' biochip technology (Image 1).

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Archer has now designed and fabricated a gFET in-house and verified the electronic operation of the device using liquid gating. The gFET is specially fabricated to prevent liquids from shorting the integrated circuit, while, simultaneously obtaining electronic signals using the liquid as part of the device.

Significant innovation is involved in the design and operation of the gFET, and includes:

+ the development of several advanced lithography processes to precisely micro- and nanoengineer an operational transistor device integrating atomically thin graphene
+ incorporating materials compatible with foundry chip fabrication processes, that can prevent fluids from electrically shorting the graphene-based transistor device
+ solving for complex on-chip fluid dynamics on the micro- and nanoscale

Image 1. Schematic of the liquid-gated gFET.
The transistor is specially fabricated to prevent liquids from shorting the integrated circuit. Several advanced lithographic processes are required to fabricate the device 'layers', while solving for complex fluid dynamics. The inset (right) shows an actual microscope image magnifying the gFET sensing region with 'open wells' where analytes in fluids would be detected by the miniaturised integrated graphene components.

Commenting on Archer's biochip development progress, Company CEO Dr Mohammad Choucair said: "The Archer team has developed a graphene-based transistor, an electronic device, that importantly for biological applications works in liquids. The transistor consists of a single-atom thick sheet of graphene to act as an ultrasensitive sensor intended to operate alongside other bio functional regions fabricated on the same miniaturised chip. The work is an exciting development towards realising an operational biochip technology at Archer."

Atom-thin graphene and its application in developing Archer's biochip

Graphene is an advanced material with electronic, chemical, and physical properties on the nanoscale that make its use in FETs for biosensing applications highly advantageous[†]. Key advantages are often described as being easy operation, fast response times, real-time monitoring, high specificity and sensitivity, microfluidic integration, and multiplexing capability. The properties of graphene have been well studied scientifically in the field for over 15 years[‡].

[†] https://pubs.rsc.org/en/content/articlelanding/2021/AN/D0AN01661F
[‡] https://www.nature.com/articles/s42005-021-00518-2 and https://onlinelibrary.wiley.com/doi/abs/10.1002/adfm.201604040

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About Archer's biochip

Archer's biochip is lab-on-a-chip technology 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 biochemical reactions to detect diseases, which pose significant technological challenges to potentially commercialising lab-on-a-chip devices.

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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