

ASX Announcement (ASX:AXE)

15 April 2019

Human antibodies printed on graphene biosensors

Highlights

- Ink formulations of human antibodies are successfully printed and patterned on graphene-based biosensor components derived from Archer's Campoona graphite (biosensor technology), supporting a number of claims and specifications in Archer's provisional patent (provisional patent).
 - Details of the provisional patent application are published in the Australian Official Journal of Patents and IP Australia AusPat database under the title "Carborane-Graphene Inks"; the claims and specifications of the provisional patent remain confidential.
 - Archer is the sole applicant of the provisional patent, maintaining 100% ownership of the biosensor technology intellectual property (IP), and has until 15 February 2020 to consider maturing the application to a full patent that would give Archer exclusive rights to commercially exploit the IP.
 - Australian Government permit for the import of biological products is obtained by the University of Adelaide, facilitating biomaterial transfer between Archer and a German biotechnology company (German Biotech) and accelerating the development of the biosensor technology.
 - Discussions with the German Biotech continue and are centred on means to establish legally binding long-term material agreements that support and demonstrate the commercial viability of Archer's biosensor technology IP.
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Archer Exploration Limited (Archer, Company) is pleased to provide an update on the Company's progress in developing graphene ink compositions and related biosensor technology (biosensor developments) as part of the Company's Collaboration Agreement with the University Australian Research Council Graphene Enabled Industry Transformation Research Hub (ARC Graphene Hub) and Material Transfer Agreement with a German Biotech.

Commenting on the Company's biosensor developments, Archer CEO Dr Mohammad Choucair said, "We were able to formulate inks incorporating process compatible biomaterials provided by our German Biotech partners, and the team at the ARC Graphene Hub were able to print them on a number of our biosensor components. This concerted effort addressed a key technical barrier to realising a globally competitive biosensor, that of digitising the manufacturing of critical biosensor componentry that could allow for multiplexing. It has provided strong support for a number of claims in our provisional patent, which legally protects this competitive advantage and provides a means for commercial exploitation of the IP."

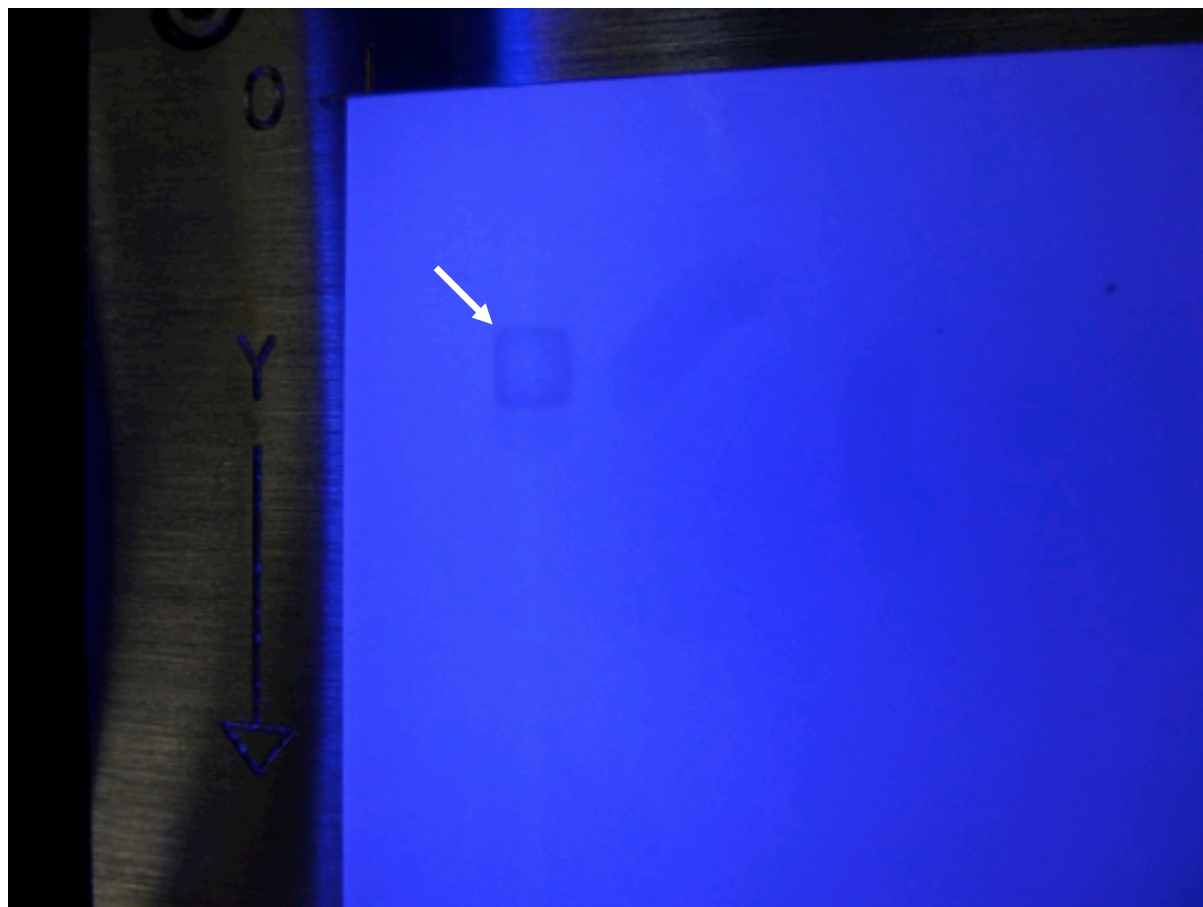


Fig. 1. An antibody ink formulation containing human immunoglobulin G (IgG) printed and patterned onto a resin-coated paper substrate using a Fujifilm Dimatix DMP-2850 Inkjet Printer. The freshly printed antibody ink is observed using ultra violet light (responsible for the blue colour) as a dark blue squared region indicated by the arrow.

Biosensors and Archer's competitive advantage

Biological sensor devices are used in the detection and diagnosis of disease. The uniqueness of a biosensor is that its critical components are integrated into one sensor. One of the biggest challenges to printable biosensors involves the scalable fabrication of integrated componentry capable of multiplexing – detecting a number of different diseases simultaneously using the same specimen. The development of printable biosensors is envisioned to impact industries servicing human health, including point of care diagnostics and medical devices.

Archer has patented a potential solution to printable biosensors capable of multiplexing. This solution involves the use of graphene, the thinnest material known which provides an ultrasensitive biochemical interface. Until recently, the robust chemistry of the graphene surface has limited its chemical versatility. Archer's materials and technology may address the challenges associated with introducing selective hierarchical chemistry to graphene, that potentially solve for chemical selectivity challenges in multiplexing biosensor technology. Integrating biological and graphene-based materials in the digitised printing processes could enable Archer's biosensor technology to be technically and commercially viable, as it would afford manufacturing and application efficiencies in the detection and diagnosis of disease. This in turn has the potential to reduce commercial barriers to rapid medical diagnosis and aid point of care disease management.

Antibody ink printing and biosensor device integration

Ink formulations comprised primarily of human antibody immunoglobulin G (IgG) as the active constituent were successfully prepared and printed using proprietary methods. Printing techniques were employed using a state-of-art inkjet printer for the preparation of basic patterns (Fig. 1). The IgG inks were printed on resin-coated paper and a number of graphene-based electrodes and were able to withstand the chemical and physical processes in the formulation, printing, and post-printing steps. The electrodes were characterised and confirmed for adequate biosensor function by a range of techniques at the University ARC Graphene Hub. Optimisation of the antigen ink formulation, printing, stability, and electrode performance is the subject of ongoing collaboration with the ARC Graphene Hub.

Intellectual property and provisional patent publication

Archer's provisional patent on the biosensor technology IP has been published in the Australian Official Journal of Patents (Volume 33, No. 8, 28 February 2019) in accordance to proceedings under the Australian Patents Act 1990 and can now be searched on IP Australia AusPat online database¹ with patent application number 2019900486. The provisional patent title is "Carbon-Graphene Inks" and has a priority date of 15 February 2018. The claims (legal definitions) and embodiments (descriptive examples) of the provisional patent remain confidential, as filing a provisional patent application does not yet provide the legal protection of a full patent application.

Archer is the sole applicant of the provisional patent, maintaining 100% ownership of the biosensor technology IP. Archer has until 15 February 2020 to consider maturing the application to a full patent. To mature the provisional patent, support of the claims in Archer's provisional patent requires detailed scientific protocols and evidence of the technical viability of the biosensor technology. This means that the exclusive right to commercially exploit the IP is fundamentally dependent on the successful technical development of the biosensor technology.

Materials transfer with German Biotech

Archer has in place a Material Transfer Agreement with a leading German Biotech (ASX announcement 27 September 2018). University ARC Graphene Hub have obtained the required permit to import biological materials from the German Biotech for in vitro use or in vivo use in laboratory organisms, and includes conditions for antibodies purified and raised against synthetic material or antigens from multicellular organisms. The permit is issued under the Australian Biosecurity Act 2015 Section 179 (1). Biomaterials in the inventory of the German Biotech have been transferred and stored in an appropriate manner and in-line with the permit conditions, at the University ARC Graphene Hub where Archer's biosensor technology is being developed.

Next Steps

Archer is in discussions with the German Biotech to cooperatively continue the development of the biosensor technology by establishing legally binding long-term material agreements. The focus is on linking claims and embodiments in Archer's provisional patent to IP and biomaterials

¹<http://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do>

in the portfolio of the German Biotech, that could accelerate the end-to-end assembly of a commercially viable biosensor technology.

Collaboration with the University ARC Graphene Hub will continue, and the focus is on optimising ink formulations and their processing methods (e.g. synthesis, printing, post printing treatments), and identifying transduction methods, bioreceptors, analytes, coupling and assay reagents for the proper function of the biosensor technology to provide strong support for the claims and embodiments in the provisional patent.

Background

Archer's multinational biosensor development

Archer is engaged in a collaboration agreement with the University ARC Graphene Hub and a material transfer agreement with a leading German Biotech (Collaborations). The Collaborations seek to target high value, high growth markets servicing human health applications by developing and implementing graphene and carbon-based materials for use in complex biosensing devices. The development of graphene inks has advanced with Archer filing a provisional patent for a novel ink formulation with the aim of fabricating a proof-of-concept printable biosensor, comprising components capable of detecting disease state markers, such as antibodies or antigens.

Market & Key Growth Catalysts

The global biosensor market revenue is expected to grow to USD\$27 billion by 2022². There is a global need for healthcare to become cheaper, efficient and more accessible³. Biosensors can reduce patient (end-user) wait times by bypassing traditional infrastructure requirements and lengthy testing processes in disease management. The key driving factors of growth are aging populations in North America, Asia and Europe. Europe is the largest contributor in the printed sensor market. Electrochemical biosensors hold a major share in the biosensor market.

Biosensors form part of the growing \$300+ billion revenue global biotechnology industry⁴. With a low industry concentration, large companies use strategic acquisitions to expand their market share and access crucial intellectual property describing products that are commercially viable. Over 75% of biotechnology businesses are located in Europe and North America. Approximately 30% of costs in the industry are related to materials, and the margin in the industry is approximately 20%-30%.

About Archer

Archer provides shareholders exposure to innovative technologies and the advanced materials that underpin them. The Company has a focused strategy targeting globally relevant advanced materials markets of human health, reliable energy, and quantum technology.

² Biosensors Market by Application, Global Forecast to 2022. Market and Markets, 2017.

³ 2018 Global Healthcare Outlook. Deloitte, 2018.

⁴ Ozelkan, A. IBISWorld Industry Report - Global Biotechnology. IBISWorld. 2017.

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