MINOTAUR EXPLORATION LIMITED
ACN 108 483 601
ASX: MEP

MINOTAUR EXPLORATION

28 October 2020

ASX Release

Natural Nanotech JV advances Halloysite uses

Summary

- Halloysite based nanocarbon (Fullerene) materials produced from Great White halloysite-kaolin and successfully activated with functional additives
- Testing of these products is showing excellent results in a range of applications including carbon capture/ conversion, hydrogen storage, remediation, energy storage and antibacterial
- Pilot plant nearing completion to produce semi-commercial quantities of extremely high value halloysite based products
- Carbon capture products proven fit-for-use
- Work on conversion of captured carbon into clean fuels in progress
- Water purification products showing exceptional potential
- New projects planned for halloysite use in medical, and agricultural applications

Background

Natural Nanotech Pty Ltd (NNT) is a research and commercialisation joint venture, equally owned (50:50) by Minotaur Exploration (ASX: MEP) and Andromeda Metals (ASX: ADN), formed to investigate nanotechnology applications for halloysite. NNT is working with the University of Newcastle's Global Innovation Center for Advanced Nanomaterials (GICAN) towards commercial solutions for high-tech applications, based on halloysite nanotube material from the Great White Kaolin JV's high-grade kaolin-halloysite deposits in South Australia.

Research Projects

Natural Nanotech's projects with GICAN are aiming to develop commercially attractive solutions for a range of high-profile environmental issues using nano-porous materials synthesised from natural halloysite-kaolin mixtures and optimised for applications including:

- Carbon capture and conversion
- Hydrogen storage
- Remediation of wastewater
- Detoxification of pollutants
- Energy storage technologies
- Antibacterial applications
- Herbicide and pesticide applications

The unique properties of NNT's nanomaterials that make them so amenable to these applications are their enormous surface area per unit weight, their porous nature and differential charge capabilities between inner and outer surfaces. Having demonstrated potential applications at the laboratory scale the GICAN team is building a pilot plant for commercial scale sample preparation and testwork, with particular reference to CO_2 capture and conversion potential of Great White Project halloysite-kaolin. GICAN is successfully developing technologies for carbon capture and, at the same time, technology to convert the adsorbed CO_2 into clean fuels such as methane and methanol, which are recognised as being future energy fuels.

With capture of CO_2 proven NNT-GICAN is now addressing selective capture of CO_2 from a mixture of gases, at different pressure and temperature conditions using the halloysite derived nanomaterial - Fullerenes.

Engineered Nanomaterials

Fullerenes are an allotrope of carbon whose molecule is in the form of a closed or partially closed mesh, with fused rings of five to seven atoms. The closed fullerenes (C_{60} and C_{70}) are being used in these studies and are informally known as 'buckyballs' due to their resemblance to a football. However, the molecule may be a hollow sphere, ellipsoid or tube and Graphene is an extreme member of the family.

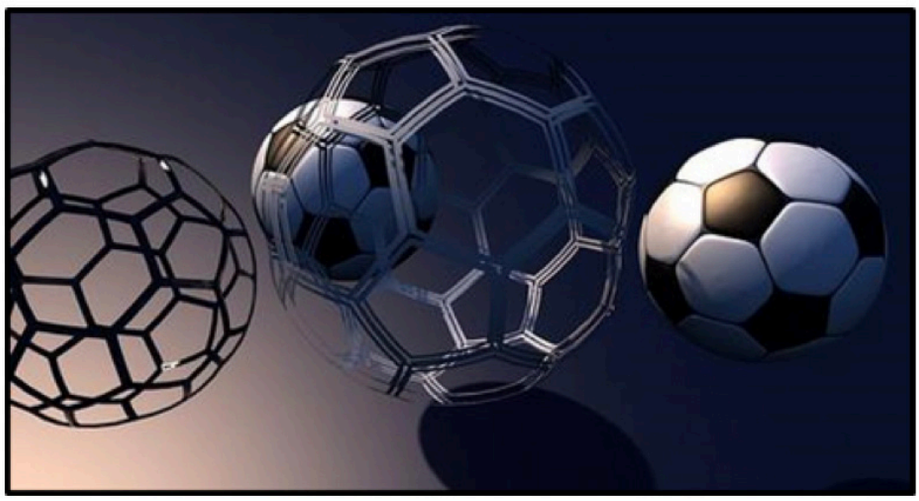

Figure 1: Fullerene Buckyball Structure

- Fullerenes are symmetrical nanocarbon molecules
- They are caged compounds with high temperature stability and electrical conductivity
- Fullerenes have unique energy levels and high electron affinity
- They are the best candidates to be employed in nanocomposites
- Commonly used types are C_{60} and C_{70}

Research is well advanced in the following multiple high-value potential applications for halloysite engineered Fullerenes:

1. in batteries and super-capacitors
2. as antioxidants
3. for the controlled release of drugs
4. as antimicrobial agents

Prof. Vinu and his team at GICAN have successfully synthesised highly crystalline porous C_{60} with an ordered pore structure and high specific surface area (~400 m^2/g), which is showing very high supercapacitance performance. They have also developed halloysite derived nanocarbons functionalized with different nanostructures which show a high peroxidase activity which may be useful for the water treatment including the degradation of organic pollutants.

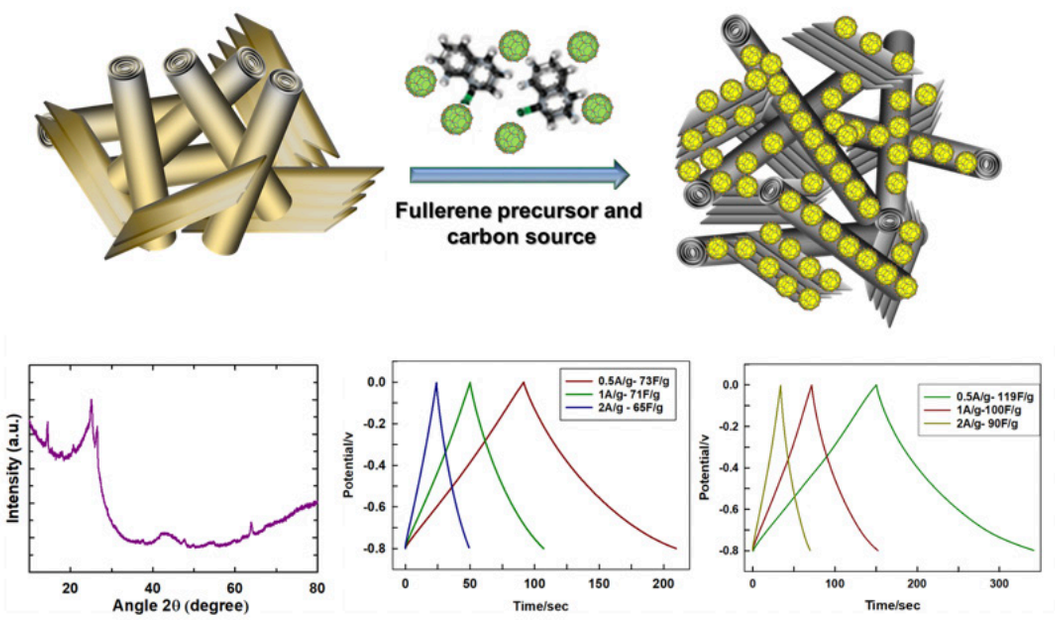

Figure 2: Fullerene Carbon nanostructures produced from Halloysite-Kaolin

Great White halloysite-kaolin was used in a simple but unique templating strategy adopted to synthesise fullerene C_{60} porous carbon. This natural material is proving to be the best alternative to very expensive commercial products currently synthesised using mesoporous silica and the process should be easily scalable at low cost.

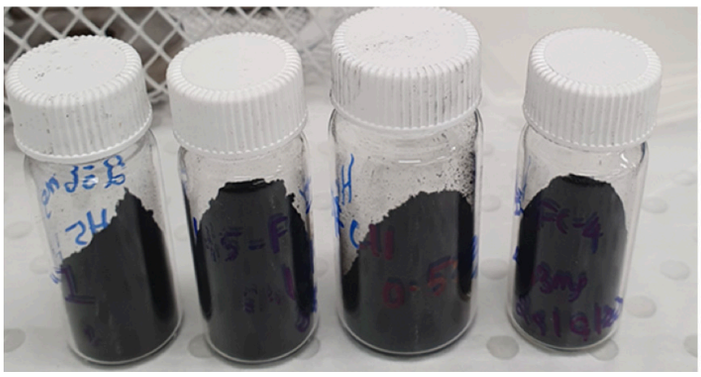

Figure 3: Nanocarbon Fullerene product made from Halloysite-Kaolin

Testing of this material for the remediation of waste water (organic and inorganic contaminants) and detoxification of pollutants such as dioxins, phenolic compounds, polychlorinated biphenyls, petroleum hydrocarbons, industrial dye effluents, herbicides, endocrine disrupting chemicals and pesticides is showing exceptional results.

R&D Outlook

Future Work is planned in the following areas:

- Functionalized Porous carbon materials for antimicrobial applications and removal of pollutants
- Optimisation of the carbon materials using varying halloysite purities
- Production and testing of carbon material in lithium ion batteries
- Completion and operation of the CO_2 capture pilot plant
- Great White High Purity Alumina (HPA) membrane coating on battery separators

Minotaur's director of Research and Development, Dr Tony Belperio stated "within the space of one year the collaboration between GICAN and NNT is already delivering research dividends and defining high-tech pathways towards commercial utilisation of the JV's world-class kaolin-halloysite resources near Poochera in South Australia. The halloysite component of the Great White kaolin deposits opens doors for a new industrial materials enterprise supplying nanoparticle feedstock to specialist users in a range of nanotechnology applications. NNT appreciates the quality research being conducted by Prof Vinu and his team at GICAN".

Authorisation

This report is authorised by Mr Andrew Woskett, Managing Director of Minotaur Exploration Ltd.

For more information contact:
Tony Belperio
Managing Director
Natural Nanotech Pty Ltd
Phone: 0417 829 942
Email: tbelperio@minotaurexploration.com.au