Project title:

Development of a novel biocomposite-integrated thin film reactor for the intensification of biosolar energy-driven gas clean-up processing

Project ID *(optional)*: *Please leave blank*

Accept all year-round applications

Funding information: Self-funded students only

Project description:

This proposed project seeks to establish an entirely new, scalable, solar energy driven microbial gas absorber technology by a novel combination of advanced photoreactive biocomposite materials, experimental thin film absorber design and modelling approaches. This is significant both for utilizing solar energy for gaseous carbon capture and the potential to significantly intensify the reactivity of photosynthetic microorganisms for gas clean-up via the development of a continuously operated, thin film bioreactor. Two versions of such a reactor will be developed: a spinning disk version and a spinning tube version. The reaction surface will be coated with a “microbial paper” containing a very high density of photosynthetic micro-organisms - a technology recently discovered at North Carolina State University (NCSU) [1]. Photosynthetic bacteria, cyanobacteria and algae can be concentrated and immobilised within an adhesive paper-based nonwoven biocomposite material formed by controlled drying into defined thinness, adhesion and pore structure. When the paper is rehydrated and illuminated, the entrapped microbes can be photosynthetically active for 100s to 1,000s of hours.

This proposed project aims to demonstrate that thin, continuous and controllable liquid films flowing over the surface of a paper-based biocomposite material can intensify gas uptake and biotransformation by a high density of entrapped photosynthetic micro-organisms. A preliminary proof of concept project has highlighted promising potential for such a technology to be developed further to achieve bioprocess intensification of CO2 uptake [2]. If successful, this technology will enable many different types of microbial biotransformations of waste carbon gases at industrial scales with applications to valorization of not only CO2 but also syngas (CO), biogas (CH4), and volatile organic carbon (VOC) pollutants.

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References (optional):

[1] O.I. Bernal, C.B. Mooney, M.C. Flickinger, Specific Photosynthetic Rate Enhancement by Cyanobacteria Coated Onto Paper Enables Engineering of Highly Reactive Cellular Biocomposite ‘‘Leaves’’, Biotech. Bioeng. (2014) 111(10), 1993-2008.

[2] Ekins-Coward, T., Boodhoo, K, S. Velasquez-Orta, G. Caldwell, A. Wallace, R. Barton, and M. C. Flickinger, A microalgae biocomposite-integrated Spinning Disc Bioreactor (SDBR): Towards a scalable engineering approach for bioprocess intensification in light-driven CO2 absorption applications, Ind. Eng. Chem. Res., 58(15), 5936-5949 (2019).

Application enquires:

Professor Kamelia Boodhoo

Professor of Intensified Chemical Processing

Email: kamelia.boodhoo@ncl.ac.uk

Webpage: <http://www.ncl.ac.uk/engineering/staff/profile/kameliaboodhoo.html#background>

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[ ]  biological anthropology

[ ]  social anthropology

[ ]  other

Architecture, Building & Planning

[ ]  architecture

[ ]  built environment

[ ]  construction management

[ ]  landscape architecture

[ ]  rural planning

[ ]  surveying

[ ]  urban planning

[ ]  other

Biological Sciences

[ ]  bacteriology

[ ]  behavioural biology

[ ]  biochemistry

[ ]  biodiversity

[ ]  bioinformatics

[ ]  biophysics

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[ ]  cancer biology

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[ ]  plant biology

[ ]  plant cell biology

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[ ]  virology

[ ]  zoology

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Communication & Media Studies

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[ ]  print media

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Computer Science

[ ]  artificial intelligence

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[ ]  computer vision

[ ]  computer graphics

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[ ]  human computer interaction

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Education

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Engineering

[ ]  acoustics engineering

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Environmental Sciences

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[ ]  other

Finance

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[ ]  insurance

[ ]  investment

[ ]  taxation

[ ]  other

Food Sciences

[ ]  food hygiene

[ ]  food production

[ ]  other

Forensic and Archaeological Sciences

[ ]  archaeological science

[ ]  forensic science

[ ]  other

Geography

[ ]  agricultural geography

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[ ]  economic geography

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[ ]  geographical information systems gis

[ ]  historical geography

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[ ]  social geography

[ ]  transport geography

[ ]  urban geography

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Geology

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[ ]  geochemistry

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[ ]  geoscience

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History & Archaeology

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[ ]  american history

[ ]  ancient history

[ ]  archaeology

[ ]  asian history

[ ]  australasian history

[ ]  british and irish history

[ ]  economic history

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[ ]  history of religions

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[ ]  social history

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Information Services

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Languages, Literature & Culture

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[ ]  english language

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Law

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Linguistics & Classics

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Materials Science

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Nursing & Health

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Philosophy

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Physics

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Sport & Exercise Science

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Theology & Religious Studies

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Veterinary Sciences

[ ]  animal welfare

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