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EBNet Environmental Biotechnology

Engineering and Physical Sciences Research Council

Biotechnology and Biological Sciences Research Council

# Simultaneous bioremediation of nutrient pollution and carbon fixation through a novel integrated anammox and acetogens-based bio-electrochemical system

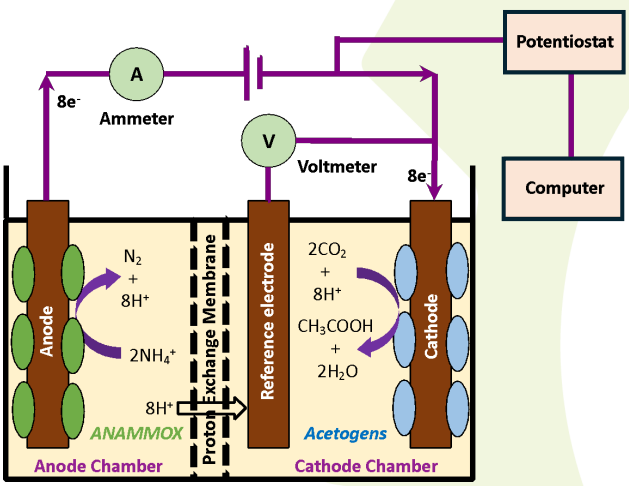
*"The novel ANAMMOX and Acetogens-based integrated, one-pot bio-electrochemical system can be instrumental in addressing both environmental sustainability and decarbonisation challenges for the UK's chemical industry sector".* **Dr Ahsan Islam, Chemical Engineering, Loughborough University**

## AIM

The carbon and nitrogen cycles are two of the Earth's most important biogeochemical cycles due to their integral roles in the Earth's living systems.

Although both cycles are seriously affected by harmful anthropogenic activities, the later cycle received less attention from the scientific community in terms of its proper management and recovery from the damage caused. Improper management of the nitrogen cycle is also associated with the accumulation of fixed nitrogen compounds, i.e. nutrients, causing severe environmental pollution, including eutrophication, acid rain, red tides, and rapid destruction of the ozone layer.

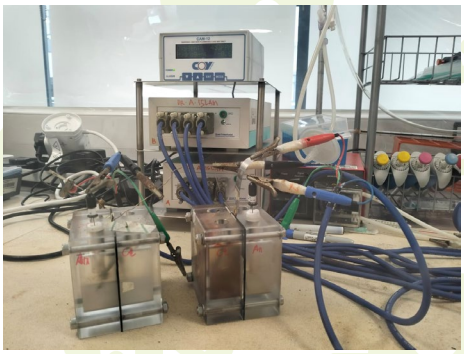
This project thus aimed to develop a novel bio-electrochemical system for simultaneous management of both nitrogen and carbon cycles by removing excess nutrients and $CO_2$ from the environment.




## RESULTS

This PoC award was used develop a novel proof-of-concept bio-electrochemical system (BES) for simultaneous management of both nitrogen and carbon cycles by removing excess nutrients and $CO_2$ from the environment. The work employed both microbial anaerobic ammonium oxidation (anammox) by ANAMMOX bacteria and $CO_2$ reduction by acetogen-enriched microbial consortia in an integrated, one pot BES to produce nitrogen gas and organic acids simultaneously by supplying electricity. The electroactive microorganisms in the integrated BES oxidised nutrients such as ammonium ($NH_4$) into inert nitrogen gas and reduce $CO_2$ into high-value organic acids, including acetate, propionate and butyrate; thereby contributing to the simultaneous bioremediation of both nutrient and carbon pollution.

Further optimisation and scale-up can be used to develop cost-effective and energy efficient wastewater treatment processes. Such a novel system can therefore be used to address both environmental sustainability issues and decarbonisation challenges in the UK's chemical industry sector.



**PLANNED PUBLICATION:**
Coupling ANAMMOX and Acetogenic $CO_2$ reduction for simultaneous bioremediation of nitrogen and carbon pollution.
By: Abbas A, Islam MA. In preparation for ACS Electrochemistry.