Bristol BREATHE Project Abstracts

General Abstract

We are an interdisciplinary team from the University of Bristol taking part in the iGEM 2017 competition (https://igem.org/), which sees student teams from around the world genetically engineer bacteria to address major issues facing the world today. A February 2017 report showed that air pollution is implicated in around 8.5% of all deaths per year in Bristol. To help manage this severe problem, we are developing a bioreactor which removes atmospheric nitrogen oxide (NOx) gases and produces the value-added product of ammonia. This can then be used for a variety of applications, such as fertiliser and electricity production.

Scientific Abstract

In recent years the environmental impact of nitrogen oxide (NOx) gases has become a pressing concern due to increases in anthropogenic sources, particularly diesel car emissions. NOx is a health risk, producing toxic ozone in the troposphere, and contributes to climate change, being an ozone depleting substance (ODS) in the stratosphere. NOx gases were not included in the Montreal Protocol (1989), which aimed to tackle the environmental impacts of ODSs such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), resulting in uncontrolled NOx pollution. Therefore the control of NOx has been less successful compared to other ODSs. NOx is now the third most detrimental greenhouse gas, behind only CO_2 and methane. In our project, we will genetically engineer *E. coli* to metabolise NOx, using the cytochrome c nitrite reductase (NrfA), which reduces nitrite (NO_2^-) to ammonia, and the Nap periplasmic nitrate reductase for the reduction of nitrate (NO_3^-) to nitrite. Nap will allow us to target a wider range of NOx and improve the efficiency of our system. This ammonia can then either be used to produce fertiliser, or electricity when used within microbial fuel cell (MFC). We will also incorporate a fluorescent reporter gene to provide a measure of productivity and create bioluminescence for street lighting; this may be more aesthetically pleasing to the general public. An open-source agent-based bacterial model will be expanded upon to predict system efficiency and behaviour on a larger scale. We plan to use existing models and data of NOx concentrations in Bristol to strategically place our recombinant bacteria in problem areas within pod structures, and aim to assemble them into larger synthetic trees, which are either self-sustaining or require low maintenance.

Sincerely,
The Bristol iGEM 2017 Team