Biology

Project title 1: Production of bioethanol from macroalgae and food wastes

The generation of excessive food wastes has become a problem in recent years. Macroalgae or seaweeds are also abundantly found in the environment, especially reservoirs. These wastes are often discarded in landfills.

These wastes are rich in complex carbohydrates such as starch and cellulose. In recent years, second generation bioethanol has been produced from lignocellulosic biomass by first treating it with dilute acid or enzymes to hydrolyse it to sugars for subsequent ethanolic fermentation.

This project aims to utilise different wastes and macroalgae as potential sources of bioethanol. The yeast *Saccharomyces cerevisiae* or the bacterium *Zymomonas mobilis* can be used to ferment the sugars available to ethanol. Both Bugil Academy and HCI can vary the wastes used, and the yield of ethanol can be compared.

Biochemistry

Project title 2: Green synthesis, characterization and application of metal nanoparticles

There is growing interest in the biological and environmental safety of the production of metal nanoparticles. The main methods for nanoparticle production are chemical and physical approaches that are often costly and potentially harmful to the environment. The project will focus on using plant extract to synthesise the nanoparticles.

Discussion notes:

1. Students will discuss and decide on the nanoparticle to work with.
2. HCI and Bugil will choose plant indigenous to Singapore and Korea. Use extract from different parts of the plant to synthesise the nanoparticles. Both side will standardise the concentration of the extract used. Measure the pH of the extract—pH may have an effect on the size / production of the nanoparticles.
3. May analyse the total phenolic and flavonoid content of the extract to screen through the extract to find out which extract is more suitable to synthesise the nanoparticles. This can be done using Folin-Ciocalteu Reagent and aluminium chloride colorimetric. It may help us to see how the phenolic and flavonoid content affect the size and shape of the nanoparticles.
   (This point was not discussed in the meeting)
4. Characterise the nanoparticles by using UV-Vis and SEM and/or TRX. Compare morphology, size and shape of the nanoparticles produced from different extract.
5. FTIR to find the type of plant metabolites which act as the capping agent.
6. Carry out antibacterial and antioxidant test for nanoparticles produced from different extract. We will also look at the effect of shape and size of the nanoparticle as well as the different capping agents on the antibacterial and antioxidant properties.

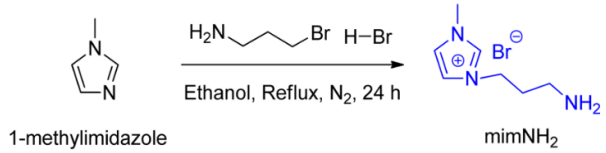
Chemistry

Project title 3: Removal of Dyes Using Ionic Liquid-Graphene Oxide Sponge

***ACS Sustainable Chem. Eng*. 2017, 5, 6026-6035**

- To prepare a methylimidazolium ionic-liquid functionalized graphene oxide sponge by facile amidation reaction followed by freeze drying.

Scheme 1. Synthesis of $mimNH_2$

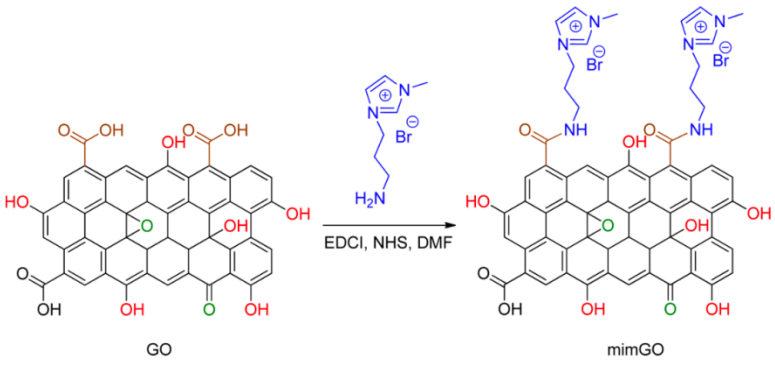


Possible Variations for imidazole based ionic liquid synthesis

Imidazole derivatives:

1. 1-methyl-2-imidazolecarboxyaldehyde
2. 2-mercapto-1-methylimidazole
3. 2-ethylimidazole
4. 1-butylimidazole
5. 1-methyl-2-methylimidazole
6. 1-benzyl-2-methylimidazole
7. 2-ethyl-4-methylimidazole
8. 1-isopropyl-2-methylimidazole

Scheme 2. Synthesis of mimGO



- To conduct detailed adsorption kinetic studies and desorption experiments

Possible Dyes

1. Methylene Blue
2. Brilliant Green
3. Methyl red
4. Methyl orange
5. Congo red
6. Eriochrome Black T
7. Sunset Yellow
8. Tartrazine