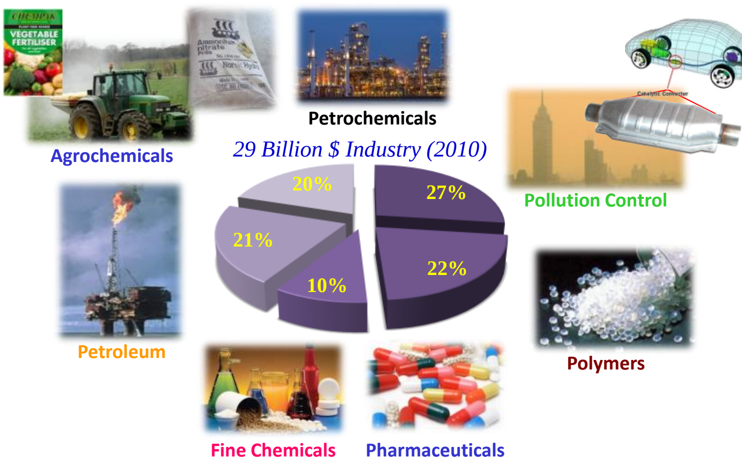
Aston University
Engineering & Applied Science

EBRI
European Bioenergy Research Institute

Surfaces, Materials & Catalysis Group

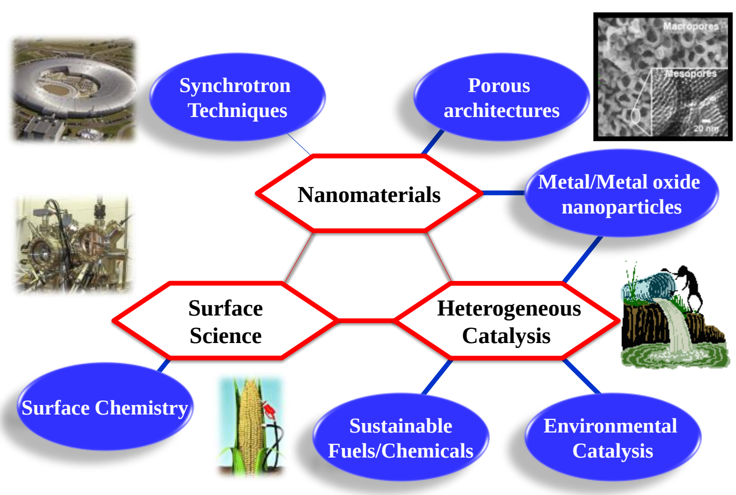
Sustainable Catalytic Processes



Catalytic technologies play a critical role in the economic development of both the chemicals industry and modern society, underpinning 90 % of chemical manufacturing processes and contributing to over 20% of all industrial products. Sustainable chemistry is defined as the design and implementation of chemical products and processes that reduce or eliminate the use or generation of hazardous substances, while employing renewable resources in an atom and energy efficient fashion. In accordance with the 12 Principles of Green Chemistry, first advanced by Anastas and Warner, catalysis is a key tool with which to develop sustainable chemistries

New catalytic routes to the manufacture of fine, speciality and pharmaceutical chemicals offer sustainable solutions with minimal environmental impact. In a post-petroleum era, catalysis researchers will need to rise to the challenge of synthesising chemical intermediates and advanced functional materials and fuels from non-petroleum based feedstocks.

Our research focusses on developing new heterogeneous catalysts for the sustainable transformation of biomass into fuels and chemicals. We are particularly interested in understanding mechanisms of surface catalysed processes and have extensive expertise in the application of n-situ spectroscopies (e.g. EXAFS, DRIFTS and XRD) to follow the evolution of catalysts during operation. Using this improved understanding of the nature of the active site and deactivation processes we aim to develop tailored catalytic materials.



In particular we are focussing on tuning pore architectures to improve in-pore mass transport of bulky reactants and products typically encountered during biomass transformation. Current projects include the design of solid acid and base catalysts for biodiesel synthesis from algal and Jatropha oil feedstocks; the development of heterogeneous catalysts for the pre-treatment and upgrading of pyrolysis oil by hydrodeoxygenation and the catalytic processing of lignocellulose feedstocks for fuels and chemicals manufacture. In addition we also have expertise in the development of catalysts for clean synthesis including alkylation, acylation, selective oxidation and hydrogenation processes.

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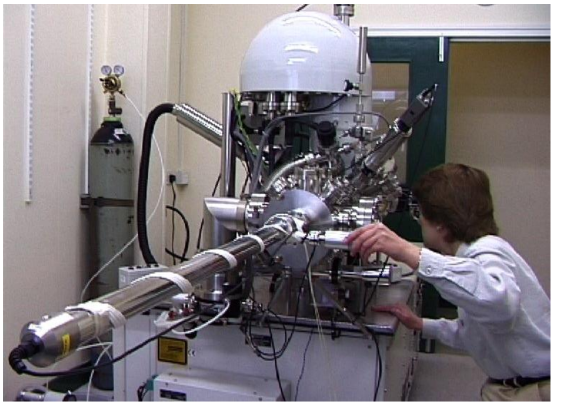
Analytical Facilities

Our lab is well equipped with facilities for the synthesis, characterisation and testing of heterogeneous catalysts. The group has a reactor suite comprising several high temperature (~1200 °C) continuous, plug-flow microreactors equipped with electronic mass flow controllers and syringe pumps for delivering accurate gas and vapour-phase reaction mixtures, together with on-line GC/MS analysis suitable for activity screening, kinetic (isotope) studies, and precise steady state/lifetime analysis.

The lab is also equipped with a range of reactors including:

- Suite of high pressure stirred Parr autoclaves with liquid sampling (10-300 bar and 120-300 °C) suitable for both materials processing and catalytic reactions;
- Reactor systems for parallel catalyst screening.
- Autosampler GC capabilities with on-column injection for oil analysis.
- HPLC equipment with Fluorescence, Refractive Index and UV detectors.

We also have a wide spectrum of materials analysis facilities including:



- An imaging XPS spectrometer with heated stage to measure surface compositions during *in situ* catalyst processing.
- Porosimeter and chemisorption analyser for surface area and acid/base and metal site titrations;
- In-situ DRIFT and DRUV cell spectrometer equipped for *in situ* catalyst reaction studies;
- *Insitu* heated ATR flow cell reactor for photocatalytic reaction
- Bruker D8 powder XRD with 100 position sample carousel and Anton Parr high pressure environmental cell.for *in-situ* catalyst characterisation.