School of Chemistry

Module Aims: Session 2022-2023

Module CH5713: Surface Chemistry and Heterogeneous Catalysis

Duration: 20 hours

Lecturers: Professor C. J. Baddeley* and Professor P. A. Wright

(*Module Convenor)

Aims: To introduce the main techniques of surface science and to understand how these techniques can be used to investigate the structure, composition and reactivity of surfaces with a particular focus on systems of relevance to heterogeneous catalysis. To introduce the important general concepts of the chemistry of heterogeneous catalysis and to describe and illustrate the main types. To derive the mechanism of catalytic reactions from experimental data.

Objectives:

1. To introduce the concepts of order and roughness when describing solid surfaces. The concept of and nomenclature associated with two dimensional crystallinity will be discussed.

2. To introduce the concepts of adsorption and desorption.

3. To introduce techniques for the characterization of solid surfaces – e.g. low energy electron diffraction and scanning probe microscopy.

4. To introduce methods of elemental analysis at surfaces.

5. To introduce techniques for the characterisation of molecular adsorbates at surfaces – e.g. surface vibrational spectroscopies.

6. To understand the role of a catalyst in relation to thermodynamics and to appreciate the relevance of catalyst activity, selectivity, deactivation and regeneration.

7. To identify the major types of heterogeneous catalysts (metals, metal oxides and solid acids) and be familiar with the general principles of their mode of action.

8. To interpret kinetic data of catalytic reactions in terms of adsorption equilibria and elemental reaction steps and to be familiar with the Langmuir-Hinshelwood and Eley-Rideal kinetic models

9. To develop the concept of an active site in heterogeneous catalysis and to apply physical techniques in characterising the catalytic centres.

10. To understand the application of chemical techniques, such as isotopic labelling and product composition, to elucidate reaction mechanism

    To examine case histories of important and topical catalytic reactions, e.g.:

11. To know the catalytic action of supported metals and in particular the platinum group metals, for example in automobile catalytic converters

12. To understand the catalytic action of solid acids, including zeolites, and the use of bifunctional catalysts.

13. To be aware of new developments of catalysis over microporous solids, including selective oxidation

14. To be aware of new developments of catalysis over nanoparticulate gold.