Catalysis: From Biofuels to Self-healing Aeroplanes

By Professor Duncan Wass - Bristol University

The lecture's intriguing title was an apt descriptor of a most interesting overview of developments in modern catalysis starting with a definition of the word itself and then proceeding to elaborate examples of catalysis involving enzymes and materials.

The word catalysis is apparently of Swedish origin and relates, in the context of chemistry, to a substance that causes or accelerates a chemical reaction without itself being affected. In order to explain the research work currently being undertaken in the field of chemical catalysis Professor Wass presented two practical examples, one from the application of enzymes to fuels and the other relating to composite materials used in the manufacture of aeroplane wings.

In terms of the practical applications of catalysis, the lecturer dealt first with the application of various catalysts currently being developed for the production of a range of fuels such as ethanol and butanol as replacements for gasoline. A problem with the former is that the energy output of 19.6 MJ /litre is way below that of petrol at 32mj/litre but that of butanol is more attractive, energy-wise, at 29mj/litre. He explained that one way to convert ethanol to butanol is by the use of the Guerbet reaction.

The lecturer then turned to the research work being done by his team and others into the application of catalysts in the field of developing self-healing properties in carbon fibre reinforced composites that are now used in the manufacture of aeroplane wings. Modern jets such as the Boeing 787 contain as much as 80% composites which are vulnerable to physical damage in the same way as existing metals but the extent of the damage can be more difficult to monitor.

The work now being developed with catalysts involves research into the insertion of minute pockets of a specific catalyst into the carbon fibre polymer matrix during initial construction. The catalyst currently being developed is scandium trifoliate which if released under physical impact is capable of generating an effective bond in the damaged polymer matrix. An added bonus from the point of view of maintenance is that the incorporation of a red dye with the catalyst could aid identification of damage in an aircraft wing although the appearance of an apparently bleeding wing might not always seem so reassuring to nervous passengers.