

mechanisms of degradation, and the role of oxygen in this process but, perhaps surprisingly, nothing at all was said of current experimental work on the development of interface barrier coatings. In metal matrix/metal fibre composites the problem of intermetallic formation at the interface, with possible deleterious effects, especially on fatigue properties, is also a serious difficulty. Some elegant experiments on wetting of ceramics by molten metals and alloys were described by Dr J. A. Champion (National Physical Laboratory). These experiments yield the kind of information that designers of composites may need when considering particular combinations of materials for specific purposes.

The only contribution which dealt with the industrial viewpoint—that of the design engineer—was given by Dr M. A. McGuire (GKN Group Technological Centre). He described two case studies in the development of metal matrix composites and outlined a model approach to designing with composites that might be considered as a substitute for conventional materials in simple engineering applications. The general conclusion—not an encouraging one for most of the participants—was that as far as the engineering industry is concerned, metal composites can scarcely hope to compete with metals—and particularly with steels—on economic grounds.

The symposium ended with some interesting ideas put forward by Mr R. W. Jones (Liverpool Polytechnic), who suggested that glass-ceramic fibres might be used as reinforcements for metals. The particular advantages of glass-ceramics over glass are that higher elastic moduli can be obtained; modulus and expansion coefficient can, within limits, be tailored to suit a particular matrix; and they are less susceptible to weakening through surface damage. Difficulties of making good strong fibres are yet to be overcome, however.

MATERIALS SCIENCE

Coating Processes

from a Correspondent

THE topic of coatings was considered at this year's autumn meeting of the Materials Science Club held in Great Malvern on November 11 and 12. In an introductory talk Dr J. E. Castle (University of Surrey) described the principal features of surfaces as boundaries between solids, and liquids or gases, and he outlined some recent work on Auger and low energy electron diffraction spectra of surfaces. This work suggests that impurities of surfaces are often different from those in the bulk material and that signifi-

cantly different crystal structures can exist in the near surface regions.

Chemically and electrochemically applied coatings on metals were the subject of talks by Dr C. J. L. Booker (City of London Polytechnic) and Mr R. Walker (University of Surrey). Conversion coatings are essentially methods of thickening or modifying the natural oxide coating of metals, by chemical or anodic treatments, to improve the degree of protection. These are widely applicable to steel, aluminium, magnesium, titanium and their alloys. The simplest treatment is known as the simple dip process which has been developed to produce coatings suitable for painting and as lubricating and corrosion resistant finishes in their own right.

Anodizing is a more sophisticated form of treatment which allows considerable control over the thickness and structure of the film produced, even to the extent of allowing colour decorative effects to be produced by optical interference in thin transparent films of titanium alloys. Electrodeposited coatings are perhaps the most widely applied metal coatings. The Pourbaix diagram provides the useful indication of optimum plating conditions. Acidic baths are usually pre-

ferred, on economic grounds, but in some instances complex electrolytes are required to ensure satisfactory deposits. The important properties in plated coatings are adhesion, porosity, internal stress and brightness, which may be controlled by attention to the preparation of the substrate, and by control of the pH, temperature and current density of the plating solution. In particular, complex additives often have a profound effect on the quality of the deposit. Mr Walker outlined the beneficial effects of benzotriazole on the internal stress and brightness of copper and nickel deposits plated from acidic baths.

Dr R. L. Apps (Cranfield Institute of Technology) described his work on the adhesion of sprayed aluminium coatings on steel and concluded that the grit blasting stage of substrate preparation was all important. Impurities derived from grit debris seem to reduce adhesion, and plasma sprayed coatings were better than those deposited by oxy-acetylene flames. Dr R. F. Smart (Associated Engineering Developments Ltd) also discussed plasma sprayed deposits. The great advantage of this technique is that almost any material can be sprayed and with suitable pre-

Octanoic Acid and Photosynthesis Inhibition

THERE is a remarkable difference between the *in vivo* and *in vitro* absorption spectra of bacteriochlorophyll *a* (BChl). In organic solvent this pigment has a single far-red absorption band at 770 nm whereas *in vivo* BChl can have several peaks in the 800 to 900 nm region. The spectral shift almost certainly results from the hydrophobic protein environment in which the BChl is sited within the bacterial membranes.

In next Wednesday's issue of *Nature New Biology*, Steffen and Calvin discuss experiments which demonstrate that concentrations of fatty acids which are known to inhibit photosynthesis do so by interacting with the pigment-protein complex responsible for channelling light energy to the reaction centres.

Steffen and Calvin have used chromatophores isolated from the blue-green mutant of *Rhodospseudomonas spheroides* strain R26. This photosynthetic bacterium has a BChl absorption peak at 590 nm and a single far-red peak at 860 nm (B590-860). Treatment of the chromatophore preparations with *n*-octanoic acid at concentrations below 10^{-2} M and at low pH causes the far-red absorption band to shift to 770 nm (B590-770). This shift is not caused by an acid or pH effect because HCl does not bring about a similar

spectral change. With higher concentrations of octanoic acid both the 590 and 860 nm bands are shifted towards the blue with new peaks at 530 and 760 nm (B530-760). The B590-770 resembles the BChl spectrum *in vitro* and B530-760 corresponds to the spectrum of bacteriopheophytin (BChl which has lost its central Mg ion).

There was no evidence that *n*-octanoic acid detaches the pigment from its protein carrier, and, moreover, the absorption shifts were reversed on the removal of octanoic acid. Steffen and Calvin argue that their spectral observations result from the protein-pigment complex unfolding in the presence of fatty acids so as to expose the BChl molecules to the solvent. Measurement of fluorescence depolarization and of light-dark difference spectra showed that this unfolding decreases the efficiency of energy transfer between the light harvesting BChl molecules resulting in an inhibition of reaction centre (P890) oxidation.

NMR studies indicate that octanoic acid molecules interact weakly with the chromatophore membrane and that the polar carboxyl group is not involved in the binding. Steffen and Calvin in fact have additional evidence for hydrophobic interaction because the neutral ester methyl octanoate can act in the same way as octanoic acid.