treatment in a vacuum to decompose it. Such a method greatly simplifies the apparatus and procedure since no pressure or super-heated steam is needed.

The catalyst, zinc chloride, helps to get a high yield; it is cheap and plentiful and can be easily handled since it is not volatile. The catalyst can also be regenerated during production so its consumption is not high. Moreover, no hydrochloric acid is present in the mixture of steam and other vapours, so the apparatus is not corroded and working conditions are improved. The acetic acid produced is free from mineral acid and can therefore be easily separated by extraction or in the form of calcium acetate powder.

NORWAY

How tantalum "rusts"

TANTALUM is a valuable metal to industry, not least because of the excellent resistance it offers to attack by liquid chemicals. At temperatures above 500°C, however, its surface reacts with any oxygen present to form flaky layers of tantalum pentoxide, Ta_2O_5. The oxidation of tantalum does not occur suddenly but starts at around 300°C. Evidence that its mechanism is rather unusual and complex has emerged from recent research.

Dr P. Kofstad of the Central Institute for Industrial Research, Blindern, Oslo, carried out experiments in which he heated tantalum from 300 to 550°C while it was enveloped in oxygen at a pressure of 1 atmosphere. He studied the mechanism and course of the oxidation process by measuring the rate at which his samples gained weight, by examining their X-ray diffraction patterns and optical and elec-

ture it gradually accelerates until it is following a parabolic curve; initial oxidation at 450 to 550°C follows the same curve. The transition from one rate of oxidation to the other is caused by the increased rate at which oxygen dissolves in the metal. At still higher temperatures tantalum pentoxide begins to form and flakes of it break away from the surface.

UNITED STATES

Plastic that stand up to heat

THE PHOTOGRAPH above shows a plasma flame playing on a plastic disc. This remarkable plastic which was described to the Royal Society's two-day meeting on new materials in London recently by Professor C. E. H. Bawn, of Liverpool University, stood up to the 5500°C flame for twice as long as a similar disc of steel.

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Dr P. Kofstad of the Central Institute for Industrial Research, Blindern, Oslo, carried out experiments in which he heated tantalum from 300 to 550°C while it was enveloped in oxygen at a pressure of 1 atmosphere. He studied the mechanism and course of the oxidation process by measuring the rate at which his samples gained weight, by examining their X-ray diffraction patterns and optical and electron photomicrographs, and—since the metal hardens when oxidised—by making micro-hardness tests. His tests confirm that oxygen is taken into solution by the solid metal and show that, at the surface, the concentration of oxygen rises sharply to a high value. Two metastable oxide phases are successively formed; then, at temperatures above 500°C, the pentoxide gradually begins to exist. The proportion of each phase present at above 300°C depends on the temperature, pressure of oxygen and time allowed for oxidation to proceed.

Dr Kofstad has been able to show that, contrary to what one might expect, the metastable oxides do not exist as surface films, but as small isolated "plates" that extend from the surface into the body of the metal. These plates have a regular pattern and tend to concentrate at the boundaries of grains and at the sites of strain. From his measurements of gain of weight he has also been able to show that between 300 and 450°C, oxidation is faster than can be accounted for simply by inward diffusion of oxygen. It follows a logarithmic curve, from which he draws an important conclusion—that at this stage oxygen atoms are being *chemically* absorbed into the tantalum. (This may not be all that happens, but it is the dominant factor and largely accounts for the formation of the successive phases.)

If oxidation is continued at this tempera-

THE PHOTOGRAPH above shows a plasma flame playing on a plastic disc. This remarkable plastic which was described to the Royal Society's two-day meeting on new materials in London recently by Professor C. E. H. Bawn, of Liverpool University, stood up to the 5500°C flame for twice as long as a similar disc of steel.

The material is an aromatic polyimide, a polymer characterised by the fact that it has rings of four carbon atoms that are tightly bound together. Developed in the Du Pont research laboratories by Dr W. M. Edwards and his colleagues, the new resin is believed to display a greater resistance to heat than any other unfilled organic material yet discovered. Hardly surprisingly, one of the big difficulties with these "refractory" plastics is how to fashion them, first into raw materials and then into components, but although these details are not yet released the company now plans a full-scale plant to manufacture polyimide resins. The aromatic polyimide is made by reacting pyromellitic dianhydride with aromatic diamines.

Already samples have been released to laboratories for field testing. They take two forms: a dark-brown material with a temperature resistance from 260 to 430°C depending on the heating conditions, christened SP or "superpolymer"; and an amber-coloured film. SP maintains its toughness and its resistance to chemicals, radiation, electric currents and wear up to 430°C. Its applications seem likely to lie in components for internal combustion engines, such as piston rings, valve seats, compressor vanes and ball retaining rings in hot-running bearings; another successful application has been to bind diamond dust to the surface of a grinding wheel—a role that