

decreased with increase in palladium content and became zero at 0.3 to 0.5 weight per cent palladium. Studies of the total apparent solubility of hydrogen, and of the proportion of absorbed hydrogen evolved during heating at various temperatures, showed that whereas solubility was unaffected by the presence of palladium the proportion of hydrogen evolved at 400°C, the temperature at which hydrogen evolution was a maximum, was considerably less for the 0.3 to 0.5 weight per cent palladium than for those of lower palladium contents. This indicates that palladium in this range of concentration is modifying the existing trap sites, since the authors consider that trapping by substitutional atoms of palladium, or other additions, is very unlikely. They consider that

the ferrite/carbide interfaces are the most important trap sites in steels and that these trap sites are modified by the alloying elements so that they adsorb hydrogen more strongly.

These studies of the effect of hydride-formers on flaking may have a wider application and should stimulate further work on the effect of these metals on the hydrogen stress cracking of high-tensile steels.

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### References

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## Novel Electronic Materials

### THEIR DEPENDENCE ON THE PLATINUM GROUP METALS

Many of the electronic devices which have emerged during the last one and a half decades rely for their operation on the use of single crystal oxides, which possess high structural and chemical perfection. The melt growth temperatures of these oxides range from 738°C for lead germanate to 2105°C for magnesium aluminate (spinel). The high melting points of both the single metal-oxide compounds and mixed systems, coupled with their high reactivity and their growth dependence on an oxygen or neutral atmosphere, severely limit the choice of materials available for containing their melts.

The chemical stability of platinum and iridium at elevated temperatures, 1500 and 2200°C respectively, and the chemical compatibility of these two platinum group metals with most oxide systems make them an obvious choice as container materials for the growth of oxides.

At the "Chemistry in Industry—the Way Ahead" Conference held at Wembley in November 1976, P.M. Welch of Johnson Matthey Chemicals Limited reviewed the use of platinum group metals in crystal growing in a paper entitled "High Purity Chemicals for Electronic Applications".

One development in platinum metal metallurgy, highlighted in the paper, which could

be of paramount importance to crystal growers—in particular for laser and electrooptic materials with melting points below 1500°C—is the introduction of a zirconia grain-stabilised grade of platinum. This material has increased strength at elevated temperature and better contamination resistance compared with pure platinum.

One category of magnetic materials that promises to be a major outlet for single crystals in the next decade is bubble domain devices used as a data storage and manipulation medium. The devices comprise a single crystal insulating substrate of  $Gd_3Ga_5O_{12}$  (GGG), on to which is deposited an epitaxial layer, 3 to 6  $\mu\text{m}$  thick, of a ferromagnetic garnet of the type  $R_xY_{3-x}Fe_{5-y}Ga_yO_{12}$ , where R is one or more rare earth ions.

The GGG has a melting point of 1725°C, and is grown by the Czochralski technique at a typical pulling rate of 5 to 8 mm/h from an iridium crucible under a slightly oxidising gaseous environment. GGG single crystal boules are now being produced commercially up to 7.5 cm in diameter, and weighing about 4 kg.

The magnetic thin films are grown at about 1000°C in platinum from a super-saturated solution of the garnet in a  $PbO/B_2O_3$  flux.

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