interaction of palladous chloride with allyl alcohol. They can be obtained in a variety of ways. The recognition of allylic binding also led to the reformulation of a number of known complexes, previously held to be olefin complexes. Typical examples are the 1:3-cyclohexadiene palladium complex which is unequivocally now known to be (XV) and the butadiene palladium halide complex now shown to be (XVI). It is now recognised that allylic species may be most important intermediates in a variety of reactions involving olefins and platinum metal salts. It seems probable, for example, that the polymerisation of butadiene by rhodium salts is of this type and doubtless other olefin reactions will be interpreted in this way in future, although considerably more experimental work will be required to ascertain the reaction mechanisms in detail.

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Precision Glaze Resistors

PALLADIUM IN NEW SCREEN PRINTING COMPOSITIONS

For use in printed circuits there is a demand for resistors with a wide range of values and good electrical properties and capable of being produced by the simple method of screen printing and firing the resistor film on to a ceramic substrate. In a paper given to the Electronics Division of the American Ceramic Society in October 1962, and now published in the *A.C.S. Bulletin* (1963, **42**, (9), 490), L. C. Hoffman, of the Electrochemicals Department of du Pont, describes the development of resistors of this type in which the elements consist of conducting glazes containing palladium and silver.

The disadvantages are briefly discussed of resistors produced by screen printing carbon-resin dispersions, and of those made by deposition and attenuation of metal films. The failure of early attempts to produce glaze resistors containing particulate oxide and oxide-metal mixtures is attributed mainly to poor resistance-temperature relationships and critical dependence of resistance values on the concentration of powder conductors in the glaze.

These difficulties, and the current noise which is characteristic of conduction between particles, are claimed to have been overcome by using glazes containing finely divided (0.1 to 0.5μ) palladium and silver as conductors. The oxidation-reduction behaviour of palladium heated in air is thought to promote sintering of the palladium and silver particles into chain-like aggregates. These are claimed to give continuous rather than particulate conduction, thereby reducing the dependence of resistance on metal concentration in the glaze, promoting heat dissipation and reducing current noise.

The resistor glazes are made by ball-milling the glassy component or frit to an average particle size of 5μ, and mixing this with the metal powders. Screen printing preparations are made by milling two-thirds of the inorganic powder with one-third of organic vehicle and controlling the viscosity of the pastes between 170 and 230 poises. The glazes are fired on ceramic substrates at 760°C.

A range of resistance values can be obtained by varying the ratio of palladium to silver and the concentration of metal powder in the glaze, and by attenuating the current path by selection of the screen printed design. The author gives data on the resistivity, temperature coefficients and current noise of various palladium-silver compositions.

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