keeping with thermodynamic properties of other alloy systems (9). Clearly, more fundamental investigations are required if mechanisms occurring in such complex assemblies are to be better understood. It is through this more complete knowledge that improvements in physical properties of thick-film materials may be presented in a rational form, appreciated and accepted by a market not renowned for its credulity.

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Advances in Platinum-Silver Thick-Film Conductors

Two new series of platinum-silver conductors, described in a recent article by S. J. Stein, C. Huang, L. Chang and G. Schultz of Electro-Science Laboratories, New Jersey (*Solid State Technology*, 1975, **18**, 25–33), are intended to supplant palladium-silver compositions in a number of microelectronic applications where traditionally the latter have been considered to offer the most attractive compromise between cost and performance. The electrical and physical performances of six compositions were evaluated; three of these compositions used a vitreous component (fritted systems) to bind the film to alumina substrates, while the remainder (fritless systems) relied upon copper oxides to form a chemical bond with the substrate material on firing. The three compositions belonging to each of the two systems form a series in which the metal ratio of silver to platinum progressively varied up to 2:1.

As anticipated, electrical resistivities of platinum-silver films fired at 930°C increased with platinum content, although films containing equivalent quantities of platinum had near identical electrical properties irrespective of whether the compositions contained glass or not. Similarly, little difference was found in initial peel strengths of soldered samples based on either fritted or fritless platinum-silver compositions. Soldered samples from both the fritted and fritless platinum-silver compositions again showed no major discrepancies in adhesion values after thermal ageing.

Ultrasonic bonding of aluminium (1 per cent silicon) wire was considered to be more efficient with fritless platinum-silver compositions than with the glass-containing counterparts, presumably because in the former case there is no danger of the vitreous component residing on the conductor surface thereby impeding the bonding operation. Highest platinum content fritless materials appear to show least degradation in adhesion on thermal ageing. On the other hand, fritted platinum-silver pastes appear ideal for thermal compression bonding of gold wires.

Compatibilities of both fritted and fritless platinum-silver conductors were assessed using three dielectric materials and a number of thick-film resistor pastes from three different systems. Fewer compatibility problems were encountered with dielectric materials when glass-containing platinum-silver conductors replaced the fritless electrode materials. All platinum-silver films in the pre-fired form were found to be compatible with resistor pastes from the three systems.

These two platinum-silver thick-film conductor systems thus appear to offer some advantages over conventional, glass containing palladium-silver compositions particularly where the complete absence of oxidation on the surface of films would significantly improve methods of circuit fabrication.