pure palladium taken from another recent paper by the same author (4). Here Dr. Reinacher discloses the existence of a ductility maximum in pure palladium at 500°C. Elongations of the order of 95 per cent were observed when palladium was tensile tested at 500°C. At 400 and 600°C the elongation values were only 30 per cent. Similar effects were observed during creep testing, the elongations at 500°C ranging from 95 per cent for failure in 5 hours to 40 per cent for failure in 100 hours. At 700°C, however, the greatest elongation reported was about 23 per cent. This decline in ductility with time and temperature above 500°C was shown to be caused by oxidation which spread from the surface layers and caused tearing at the grain boundaries. Above 870°C, the dissociation pressure of the oxide, strings of fine porosity developed along the grain boundaries.

These results explain the poor creep properties of palladium, but are not easily reconcilable with the observations of the ternary alloy research. It is conceivable that palladium facilitates the entry of oxygen into rhodium-platinum alloys but the effect only becomes appreciable when 10 per cent of palladium is present and when the temperatures exceed 1250°C. Any advantages resulting from the addition of palladium to rhodium-platinum alloys appear to be marginal, and only apparent over a limited temperature range. Outside this range the effects are detrimental. The results of some recent American investigations (5) indicate that platinum alloys containing up to 40 per cent of rhodium display high strength and appreciable ductility at 927°C. At 1450°C this alloy was able to withstand a stress of 800 pounds per square inch for 100 hours. Limitations of the apparatus did not permit of elongation measurements at this temperature. These three researches do, in fact, confirm that no alloys having high temperature properties superior to those based on the rhodium-platinum system have yet been developed.

A. S. D.

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A Thermocouple for Transient Temperatures

RELIABILITY OF SPRING-LOADED OPEN-CONTACT PROBE

In the investigation of materials for use in the construction of missiles and spacecraft, accurate methods of measuring high transient surface temperatures are essential. At the Lockheed Missiles & Space Company a spring-loaded open-contact thermocouple probe has been developed and its design and performance are described by P. M. Hahn in a recent paper (*Materials Research and Standards*, 1962, **2**, (5), 403–404).

Initial tests were made with a spring-loaded tantalum-sheathed platinum : 13 per cent rhodium-platinum thermocouple and a hammer-welded platinum : 13 per cent rhodium-platinum thermocouple in the measurement of surface temperatures of molybdenum and copper discs $\frac{1}{8}$ inch thick. Results obtained showed that the response of this spring-loaded thermocouple was too slow for accurate measurement of rapidly increasing temperatures. A new type of open-contact probe for the spring-loaded thermocouple was then designed. In this, the thermocouple wires, 0.010 inch diameter, are insulated by an 0.071 inch diameter ceramic tube which is itself sheathed with stainless steel 0.012 inch thick. An air gap separates the spherical tips of the thermocouple wires, the material under examination serving as a common conductor. Tests using this open-contact thermocouple with spring loads of 2 to 4 pounds on heated copper and molybdenum discs gave results in excellent agreement with those obtained with the hammer-welded thermocouple. Accuracy was maintained with temperature increases of up to 800°C per second and with temperatures in excess of 1200°C.