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Potential Uses of Ruthenium-Molybdenum and Ruthenium-Tungsten Alloys

It has frequently occurred that basic work on an alloy system has been undertaken with one particular technology in mind but that progress has eventually taken place on an entirely different front. Such appears again to be the case with the ruthenium-molybdenum and ruthenium-tungsten systems, both of which, among a number of other refraction noble metal systems, were studied closely (1) some ten or more years ago for possible use in nuclear reactor technology.

Interest in them has now been revived, and in a paper from Bell Laboratories, Murray Hill, New Jersey (2), William A. Royer and his associates report that while evaluating materials for superconducting properties they noticed that films of ruthenium-molybdenum and ruthenium-tungsten deposited on thin sapphire slabs did not dissolve in the standard etching solution. The group thereupon re-examined Mo_5Ru_3 and W_5Ru_3 and re-established that these refractory alloys are very hard and scratch resistant, make adhesive films and are moderately reflective.

These properties, together with their high melting points and good acid resistance, suggested that such alloys might be useful in electrical contacts, for example in relays operating in corrosive atmospheres. Other possible applications where a durable coating is required include various cutting edges, die surfaces, and also mirrors in instruments for measuring the degree of atmospheric pollution.

The Bell workers deposited their films by sputtering on to heated sapphire substrates at 400 to 700°C. The films were up to 10 μm thick and their crystal structure depended upon the temperature of the substrate during deposition. The Bell team also found that the temperature coefficients of resistivity of these alloys could be varied between negative, zero and positive according to the temperature of the sapphire substrate during deposition. For W_5Ru_3 values ranged from -100 to $+100$ p.p.m./°C between 25 and 600°C. Such control of the temperature coefficient is valuable for thin film integrated circuitry as it allows thin film resistors to compensate for temperature induced changes in other components of a circuit.

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