

Surface Treatment of Titanium with Palladium

AN ECONOMICAL CORROSION PREVENTION PROCESS

Titanium, which has excellent resistance to corrosion, thus making it suitable for corrosive conditions in chemical engineering, has rather poor resistance to non-oxidising acids, and equipment for handling chlorides, for example, is often fabricated from palladium-titanium alloy, which resists crevice corrosion in particular.

A low-cost process for the surface treatment of titanium with a very thin coating of palladium has now been developed by Reiji Kawashima and Kineo Yamaguchi of Nippon Mining Co (*Chem. Econ. Engng Rev.*, 1969, (Dec.), 20) to enhance the corrosion resistance of titanium. This process is claimed to give results comparable to those obtained with palladium-titanium alloys.

The palladium is deposited on the surface of the titanium by electroless immersion plating (details of the plating process are not provided), and the coated metal is then heat treated to give a thin surface layer of a palladium-rich titanium alloy. The amount of palladium deposited is so small that it can be detected only by use of the isotope Pd^{109} , but electron microprobe analysis of the alloy formed after heat treatment revealed a palladium-titanium alloy of $\sim 10\text{--}20\mu$ thickness, which the authors claim is similar to that formed by a palladium-titanium alloy.

Potential-time curves are presented that compare the behaviour of titanium, 1 per cent palladium-titanium and palladium-plated titanium in 5 per cent and 80 per cent sulphuric acid at the boiling point and at 25°C , respectively. In 80 per cent H_2SO_4 the 1 per cent palladium-titanium alloy shows an initial rapid decrease in potential followed by a rapid increase to a potential that is more positive than the Flade potential, i.e., the

metal is then passive. On the other hand palladium-plated titanium attains a potential well above the passivation potential immediately on being introduced into the acid, which indicates that it is superior to the alloy. (Examination of this curve shows that after 22 hours the potential of the palladium-coated titanium falls rapidly to a value more negative than the passivation potential, but the authors make no comment on this aspect of the potential-time curve.)

The corrosion rates of titanium, 0.15 per cent palladium-titanium and palladium-plated titanium (heat treated at low and high temperatures to form the alloy layer) in hydrochloric, sulphuric, phosphoric, and acetic plus sulphuric acids have been studied and the results demonstrate the effectiveness of palladium plating in enhancing the corrosion resistance of titanium. The authors have also studied the crevice corrosion of titanium and palladium-coated titanium in boiling 42 per cent magnesium chloride plus 0.001M hydrochloric and again demonstrate the effectiveness of palladium in controlling this form of localised attack.

The authors claim that palladium-coated titanium provides an economic method of enhancing the corrosion resistance of titanium, and that the corrosion resistance of the coated metal is equal, or superior, to the palladium-titanium alloy. The palladium-coating process, which has the advantage that it can be applied to selected areas of the titanium structure, should have important applications in the petrochemical and other industries, and should be particularly useful for titanium structures immersed in seawater, where crevice corrosion is known to occur with uncoated titanium.

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