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Wear Patterns and Life Time of Electric Contacts

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Gold plates are widely used for high performance connectors. Pure gold is very soft. In order to improve wear resistance of gold plates, hard gold is usually used. The high hardness is achieved by alloying elements such as cobalt, iron or nickel. With increasing rate of alloying element the hardness of gold plates is increased. On the other hand, the alloying elements decrease the electrical conductivity, the corrosion resistance and the formability of gold plates. Our investigation shows that the wear rate of the hard gold plates at the contact area is still very high. The depth of the crater at the contact area very soon exceeds the thickness of gold plates during the wear tests. Since the nickel underplate, the barrier layer, is very sensitive to fretting corrosion, the electric contacts must electrically fail at this stage, due to the strong increase of contact resistance. However, many electric contacts do not fail at this stage and at stages far beyond. Two very different wear patterns are the reasons for this phenomenon.

Different amount of gold, alloying elements, nickel and elements of base metals can be found at the bottom of the crater at the contact area by means of energy dispersive X-ray analysis (EDX). Depending on the lateral and spatial distribution of these elements, quite different electrical behaviors of electric contacts are observed.

Therefore achieving the favored wear pattern, not increasing wear resistance alone, should be the goal of gold modification for increasing the life time of electric contacts.