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SCANNING ELECTRON MICROSCOPY OF CORRODED EAR PIERCING STUDS IN A CULTURE MEDIUM

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INTRODUCTION

Commercial ear piercing studs are usually made of austenitic stainless steel or other Ni containing alloys. In recent years, nickel contact dermatitis has increased, mainly among the male population, due to their growing habit of wearing earrings[1]. Scanning Electron Microscopy (SEM) of the surfaces of gold coated commercial ear piercing studs has shown that defects are common in these coatings. Defects expose the metallic substrate (Ni containing alloys) to body fluids that contain aggressive species which leads to corrosion and leaching of Ni into body fluids[2]. Nickel contact dermatitis, is caused by Ni^{2+} ions, which bind to carrier protein and this nickel-protein complex activates immune reactions[3]. The aim of this study was to investigate the presence of defects in two commercial gold coated studs and their corrosion and cytotoxicity response after immersion in a cell culture medium [4].

MATERIALS AND METHODS

The materials tested consisted of two types of commercial studs used for ear piercing: gold coated austenitic stainless steel and gold coated copper-zinc alloy containing Ni. The studs were immersed in a cell culture medium for 20 days. Instrumental neutron activation analysis of the culture medium was carried out after 20 days of immersion of the studs to identify the elements released due to corrosion. Their surfaces were observed by SEM before and after the immersion test to investigate the presence of defects in the coating and their corrosion/cytotoxicity response.

RESULTS AND DISCUSSION

Examination of the gold-coated stud surface by SEM, before the immersion test, revealed the presence of defects in the coating (figure 1). Localized attack was seen at defects in the coatings on both the studs after 20 days of corrosion test, as figure 2 illustrates. The presence of aggressive elements such as chlorides in the corroded area, detected by EDS analysis, suggests that the chlorides from the culture medium may have initiated corrosion. SEM observations showed cracks in some areas and detachment of the external surface of the gold coating due to corrosion (figure 3). Corrosion can therefore lead to the exposure of new areas of the substrate to the physiological medium and further erosion. Significant amounts of Ni were detected in the culture medium after the studs had been immersed for 20 days and both types of studs showed cytotoxicity in a cell culture.

CONCLUSIONS

SEM observations indicate that there is need for improvement in quality control of the gold coating process of ear piercing studs. This would help to avoid the formation of defects which expose the substrate to body fluids, and consequently, the corrosive attack on the substrate and liberation of toxic/allergenic elements.

REFERENCES

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Figure 1. Arrow points to defect in the coating prior to corrosion test.

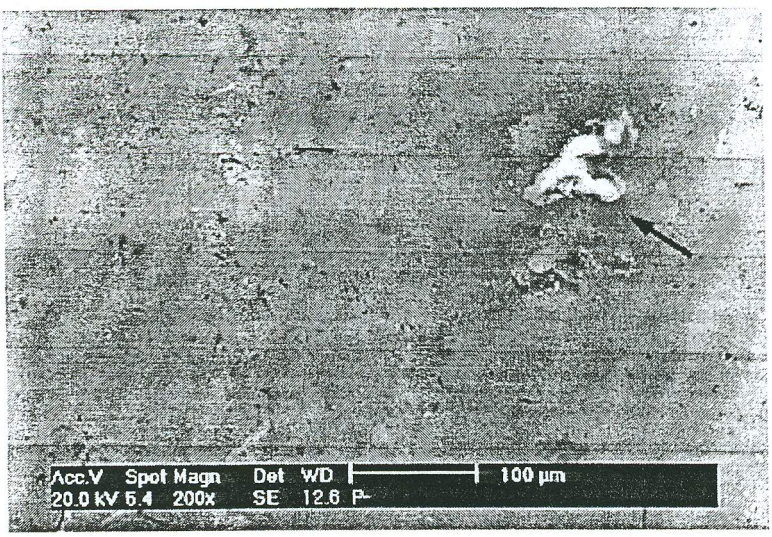

Figure 2. Localized attack at a defect in the coating after 20 days of corrosion test.

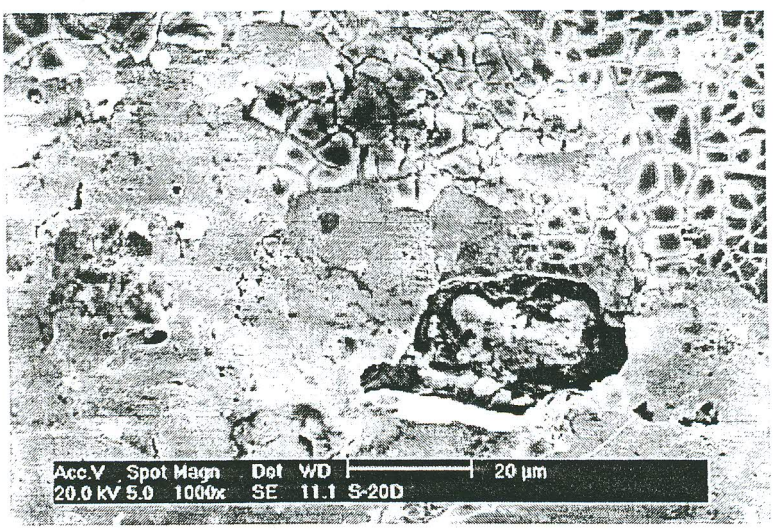

Figure 3. Cracks in the coating and detachment of the external surface of the gold coating.