

SUPERFICIAL AND MICROSTRUCTURAL CHARACTERIZATION OF ALUMINA COVERED WITH AN ELECTROLESS Ni LAYER.

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The electroless process began with Brenner and Riddell *apud* Shirastava [1], using nickel-phosphorus baths in electrodeposition experiments. Actually, the bath compositions are very stable and their behavior is predictable over long periods of time and in different experimental conditions. They guarantee excellent physical and metallurgical properties on the Cu layers, similar to films from electrolytic baths. The minimal necessary conditions for electroless depositions to occur involve a metallic salt and an adequate reactor agent. An additional requirement is that the solution be stable over an adequately catalyzed surface. The deposition is begun over this surface and maintained by the catalytic nature of the metallic surface on which it is deposited. The chemically deposited film has many applications in the areas of aerospace, automobilistics, electronics, telecommunications, medicine, nanotechnologies, and others [2]. Since the decade of the 30's, several fabrication techniques have been studied and developed to produce metal/ceramic brazed components for high-technology applications including: aerospace, electro-electronics, vacuum, energy and particle accelerators [3, 4]. The aim of this study is to verify the deposition aspects and chemical composition of NiP coating, chemically deposited over an alumina substrate, for metal/ceramic brazing. High alumina samples were prepared using a chemical NiP bath. Two classes of samples were brazed to an FeNiCo alloy, a low thermal expansion coefficient alloy, with AgCu eutectic filler metal, in a vacuum furnace at LNLS. Two groups of samples were prepared: the first "as received" and the second submitted to several heat-treatment cycles at a moderate temperature to verify the influence of temperature and time on the Ni coating. This second group of samples was submitted to 40 cycles of heat treatment for 2 hours at 25°C in an oxidizing atmosphere. All samples were submitted to a four-point bending test using an INSTRON 8511 universal testing machine to verify the mechanical resistance of the joints. The fracture surface, transverse section and Ni coating were observed in a JEOL scanning electron microscope. All of these experiments were developed in the Department of Materials Science and Metallurgical Engineering of the Polytechnic University of Catalonia, Barcelona - Spain. All samples submitted to the flexural four-point test failed in the metal/ceramic interface. A transverse view of metal/ceramic interface (Fig. 1) shows a failure between the eutectic AgCu filler metal (left) and the alumina sample. The study of the Ni coating showed that it was not continuous, but consisted of small particles with a diameter of approximately 250 nm (Fig. 2). The EDS chemical analysis did not indicate the presence of oxides or reaction products in the Ni - alumina, Ni - filler metal interfaces or in the Ni particle (Fig. 3). It was observed that the Ni particles were present on the entire surface and the internal surface of the ceramics was also porous. An X-Ray Mapping of nickel was done in alumina metallized samples, as a second technique to verify the Ni distribution over the alumina surface (Fig. 4 and 5). These analyses confirm the non-homogeneous distribution of the nickel layer over the ceramic substrate. The heat-treated samples did not present changes in the particle sizes and shape and the chemical composition and interface were not changed. The fracture aspects showed a plane fracture mode, without metallic parts joined to the ceramic component (Fig 6). In preliminary conclusions, the coating produced by the NiP bath is not continuous, but covers a large area of the ceramic samples; their chemical composition was not affected by heat treatments at intermediate temperature.

References

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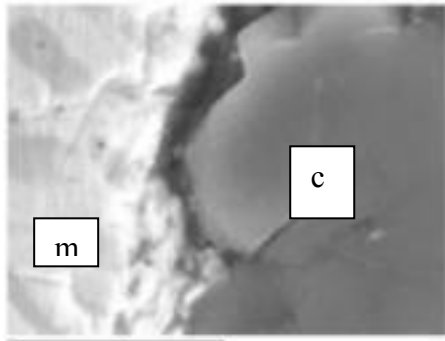


Figure 1 – Interface metal (m) / ceramic (c).

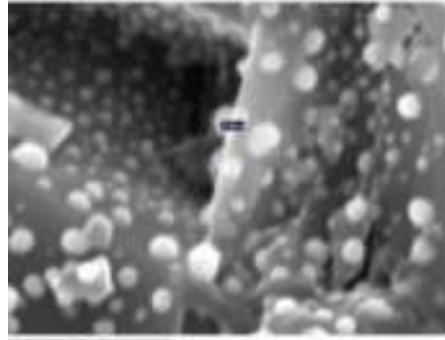


Figure 2- Ni particle over alumina substrate.

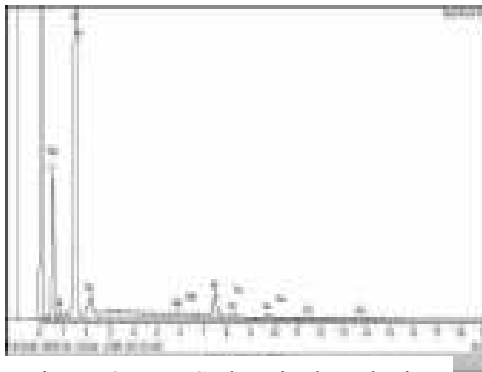


Figure 3 – EDS chemical analysis on a ceramic substrate.

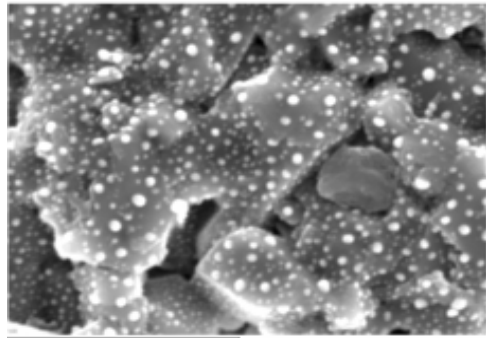
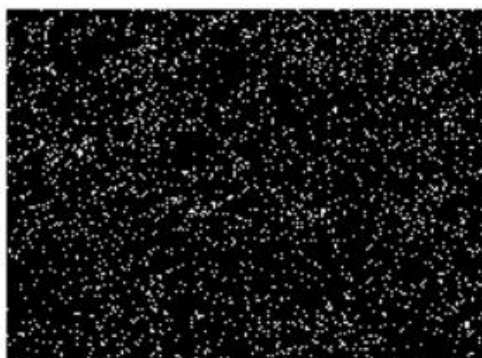


Figure 4- Region for X Ray Mapping on a ceramic surface.



Nickel Ka1

Figure 5- X Ray Mapping for Ni on an alumina substrate.

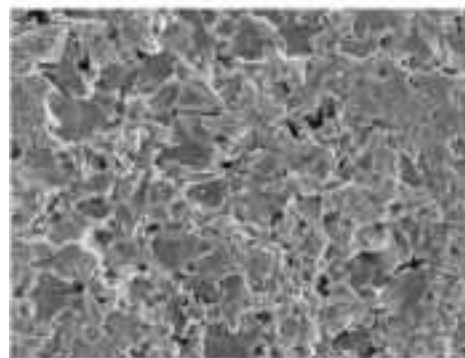


Figure 6- Fracture interface of a ceramic.