NiPdAu-Surface Finish - Being Ready for the Future

NOORDWIJK, THE NETHERLANDS 20-22 MAY 2014

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ABSTRACT

Although space industry is not bounded to the REACH act dealing with the elimination of Pb in production processes, the number of supplier for Pb-containing chemicals or components is decreasing. Therefore the demand especially of the PCB industry for alternative surface finishes that will be suitable for space applications and approved by ESA (European Space Agency) rises. The NiPdAu-surface seems to be a promising candidate as it doesn't have the issue with the formation of black pads and also offers other advantages in comparison with PbSn-surface finish. Tesat Spacecom GmbH & Co. KG has invested into this new process and will summarize the experiences and results in order to highlight a possible way for future space suitable PCB-surface (printed circuit board) finishes.

1. INTRODUCTION

The REACH act drives the demand for alternative surface finishes to PbSn refused that will be suitable for space applications.

The ENIPIG-process (electroless Ni / immersion Pd/ immersion Au) (fig. 1) has the following advantages for manufacturing and was therefore chosen:

- Stable process
- Reduced costs compared to ENEPIG (electroless Ni / electroless Pd/ immersion Au)
- Good bonding quality
- Diffusion barrier

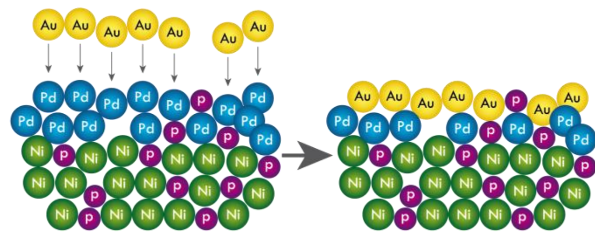

Figure 1. ENIPIG-process [1]

Tesat Spacecom therefore has invested in a NiPdAu PCB surface-finish-line (fig. 2) and has performed investigations with the surface finish (fig. 3,4).

Figure 2. The ENIPIG-plating line (Galvabau) at Tesat Spacecom GmbH & Co.KG

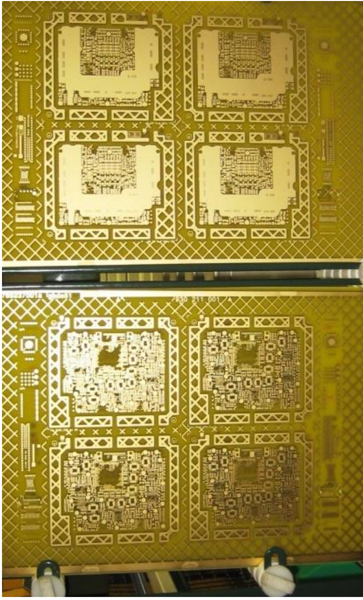

Figure 3. PCB samples with an ENIPIG-surface finish produced with the new plating line

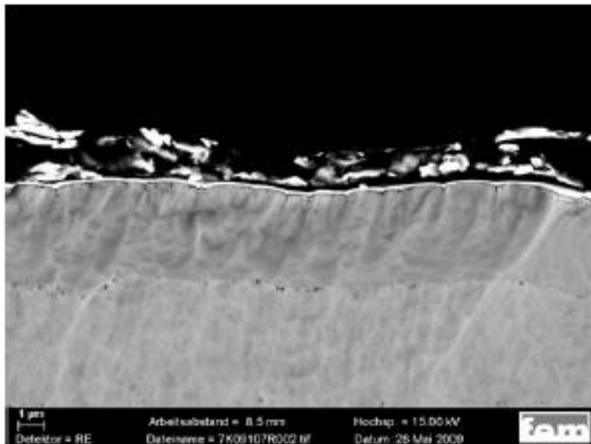

Figure 4. SEM-picture of ENIPIG in a micro-section

2. INVESTIGATIONS AND RESULTS

The N-diffusion for different Au-surfaces has been studied by the chemical supplier Umicore and as shown in fig. 5 Pd serves as a good diffusion barrier for N and reduces the risk for the formation of black pads. Thus the surface finish shows good solderability and bondability properties even after harsh ageing conditions as no black pad formation is observed [1,2]. An additional major benefit of NiPdAu compared to ENIG (electroless N/ immersion Au) or PbSn is the direct application of Au-bonding on the surface. It is also suitable for lead-free solders.

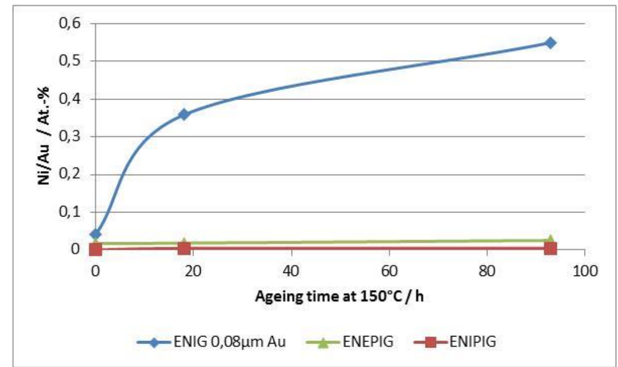

Figure 5. Ni diffusion to the pad surface (EDS/XPS) depending on ageing time at 150°C [1]

Internal investigations have indicated stable ball-shear values and also high wire pull values even after soldering and altering (fig. 6,7) if sufficient cleaning is applied.

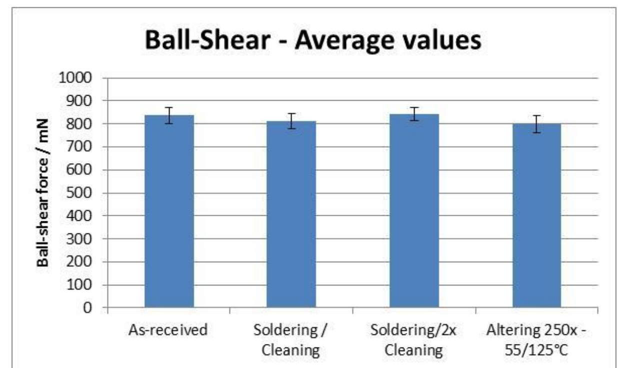

Figure 6. Average values for ball-shear tests for different ENIPIG-surface stages

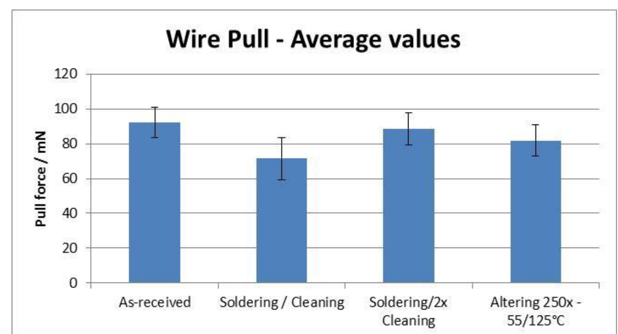

Figure 7. Average values for wire pull tests (20µm Au-bonds) for different ENIPIG-surface stages

Tesat Spacecom was able to show that NiPdAu can be manufactured with a stable process (ENIPIG) and good bonding and soldering results were achieved proving that NiPdAu is a possible way for a future space suitable PCB-surface finish.

[1] Umicore GmbH. (2009). Nickel-Palladium-Gold Finishes for soldering and bonding, presentation Umicore GmbH, Germany

[2] Sitte, N. (2009). Palladium as diffusion barrier – a way to a multifunctional printed circuit board. *Printed circuit information*

[3] Tesat Spacecom GmbH &Co.KG. (2011). Wire bonding, internal paper, Tesat Spacecom GmbH & Co.KG, Backnang, Germany