Cu-plating R&D at CERN-DESY

L. Ferreira, 08.11.2013

Vacuum Surfaces Coatings

Electroplating on Stainless Steel

Stainless Steels are self passivating Iron alloys and direct plating gives poor or non adhesion of plated metals if care is not taken in the choice of baths and preparation procedures.

In vacuum applications, 316LN is commonly used for the assembly of parts. Typical composition:

Cr = 16-18.5%	Primary element for formation of passive film
Mn max. = 2%	Promotes repassivation
Ni = 12-14%	Promotes repassivation
P max. = 0.045%	
Mo = 2-3%	In combination with Cr stabilises passive layer, even in presence of Cl.
S max. = 0.030%	
C max. = 0.03%	
N = 0.14-0.20%	Within certain conditions N reacts with residual B (0.0005 to 0.003%) to form BN. CERN trials shows that BN forms when B≥9 ppm and for heat treatments in the range 700°C to 1150°C
Si max. = 1.0%	
Fe = remainder	

Electroplating on Stainless Steel

The most common path to electroplate on stainless steel is to use very low pH baths to remove the passive layer and plate an interface layer between stainless steel and the functional metal to be plated. The most used baths to apply this strike layer are:

- *Au III complex,* → Expensive, specially if a large volume is to be prepared
- *Ni Wood,* → Relatively low efficiency (~60%, H2 evolving)
- *and Cu, HCl based bath.* → Possible re-oxidation after strike plating

Even in these very low pH conditions and in presence of Cl ions, the BN film remains untouched. Within CERN experience, only an anodic etching (electropolishing) is capable of removing this layer and allow electroplating.

Agreement subject:

a) Measurement of RRR on Stainless Steel copper plated samples *(CERN procedure);*

b) Feasibility study for copper plating on stainless steel X-FEL couplers components (*within CERN present know-how and installations);*

c) Support to X-FEL industrial partners (tbc);

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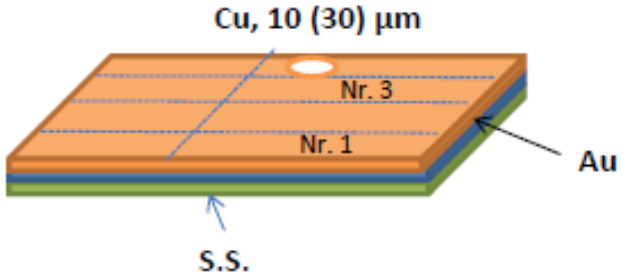
Present status:

a) Measurement of RRR on Stainless Steel copper plated samples *(CERN procedure);*

Cern

	Cu, 10 µm		Cu, 30 µm	
	Nr.1	Nr. 3	Nr.1	Nr.3
$RRR_{Cu+Au+S.S}$	10.05	11.3	28.1	32.4
$RRR_{S.S.+Au}$	1.4	1.4	1.4	1.4
RRR_{Cu}	38.2	37.6	62.05	67.4

DESY
MPL Group
29.10.13



RRR measurements made at DESY on CERN samples

Present status:

a) Measurement of RRR on Stainless Steel copper plated samples *(CERN procedure);*

b) Feasibility study for copper plating on stainless steel X-FEL couplers components (*within CERN present know-how and installations*):

- Assembly of supports on mockup parts;

- First trial foreseen in Dec. 2013;

Cu-plating R&D at CERN-DESY

Present status:

a) Measurement of RRR on Stainless Steel copper plated samples *(CERN procedure);*

b) Feasibility study for copper plating on stainless steel X-FEL couplers components (*within CERN present know-how and installations)*:

- Assembly of supports on mockup parts;

c) Support to X-FEL industrial partners;

- Check cleaning and plating procedures;

- Surface analysis on problematic flanges (peel-off);