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# 2008 Status report on SALAF technical activity on X-band linear accelerating structures project at Frascati Laboratories.

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## ELECTROFORMING

The galvanoplastic procedure to obtain R.F. structures by Copper deposition has been studied and tested also during 2007 and first month of 2008.

As already said, essentially two are the points under study:

-the quality of the roughness of the inner surface

-the use of the Electroforming as a "cold brazing".

### Roughness.

The standard procedure to obtain an electroformed structure, as already described, is to prepare an Al core on wich Cu is deposited. At the end of the deposition a Sodium Hydroxide chemical etching eliminates the inner Al core (fig. 1).

This treatment generally makes worse the quality of the Cu surface faced to the Aluminium. In order to reduce this effect two different procedures have been studied:

The first one is to use a strong acid attack after the NaOH treatment and this gives a Cu surface of good quality, as tested. Therefore now the intention is to prepare in this way a three cells structure, ready for R.F. power tests, possibly during 2008.

The second way is to put a Gold layer on the Al core structure, so avoiding the contact between NaOH and Copper. Copper will be deposited on the Gold layer (fig. 2).

Really the first tests did not give a significant increase of the quality of the Cu surface. This can be explained considering that Gold easily diffuses into Copper and therefore it disappears, then NaOH can go in contact with Cu (the Au layer, obtained by Sputtering, is very thin, roughly 1 micron).

Usually, as a standard practice, to avoid the diffusion of Au into Cu a thin layer of Nichel is interposed between these two metals, because Au atoms do not move inside Nichel.

Based on these considerations presently two tests have been prepared:

The first one with two thin layers (1 micron) of Au and then Ni deposited on Al core by Sputtering

In the second case the above layers have been obtained by Galvanoplastic procedure and their thickness is higher (roughly 10 microns each).

The samples have been given back just now. At a first study the sputtering procedure seems not to give good results, regarding the quality of the surface. The same can be said for the samples obtained with the electrodeposition of Au and Ni, but in this case the NaOH treatement seems to have left a layer of unknown oxide on the Gold (fig. 3). In any case, study and other work is requested in this field.

Coupler.

The first tentative to obtain an Electroformed Coupler gave rather good results. Anyway the shape of the connection between waveguide and central cell has to be modified. For this reason a second Al core is going to be completed. Then it will be sent to our Galvanotechnic Company for the Cu deposition (fig. 4).

A couple of months will be necessary to have it back.

Other materials.

Presently some other materials, in addition to the Copper, are under study: essentially Molybdenum and alloy Copper – Zirconium.

Regarding Molybdenum some electroformed multicell structures with Mo irises have already been made with good results (see 2007 report). These prototypes were made only to check the procedure.

For these special materials the Electroforming technique could be used as a way to "encapsulate" the components of the multicell structures, making something like a "cold brazing" of the multicell elements, as well as the end flanges.

The above procedure will have the advantage to avoid the high thermal stress of these metals during the brazing. In particular this is valid for the Cu/Zr because it loses its RF properties above a 300  $^{\circ}$ C treatment.

Finally the way to obtain electroformed multicell structures with the presence of two tuners per cell will be considered as soon as a proper tuner structure designed for this procedure will be tested.

BRAZING.

3 cells structures.

A three cells Cu RF structure is close to be completed in order to send it to SLAC for power tests. Two tuners per cell are present(fig. 5-6).

This structure will be send complete with a Sputter Ion Pump Vacuum System, therefore ready for RF power tests.

Work is in progress also for a structure as above but completely made in Molybdenum. Its machining is already done and a roughness of Ra = 0.35 micron is obtained, also on the irises.

Presently brazing tests are in progress in order to define the best procedure and the proper brazing alloys to join Mo - Mo and Mo with Stainless Steel.

The Ag/Cu alloy generally used for Cu can not be used for Mo.

The alloys of Palladium/Copper/Silver are presently under test. They have different melting points (corresponding to different compositions) therefore they can be used in sequence to complete the whole structure step by step.

### Tuners.

Essentially there is a small threaded shaft that can be moved by a proper device. In this way the volume of each cell can be modified, if necessary (two tuner per cell are forseen). The shafts are brazed on the cell. The way to have them directly machined on the cell is under study.

## SUMMARY OF THE WORK IN PROGRESS.

- Define the procedure to obtain the best surface quality fo the Electroformed cells (acid treatement or a protection layer of Gold).
- Prepare an Electroformed 3 cell Copper structure complete with flanges and vacuum system for RF power tests.
- Study the possibility to obtain the tuner shafts only by machining, not only for Cu but also for Mo and Cu/Zr.
- Prepare a Mo structure, complete of tuners, using Electroforming.
- Define the proper geometry and the proper electroerosion machining procedure for the Cu Coupler as well as for an Al Coupler to be prepared for Electroforming.
- Define the proper procedure and suitable alloys to use for the brazing of the Molybdenum.
- Study the best way to obtain Cu/Zr structures, with the study of the proper solutions for brazing, electroforming, tuning, coupler machining and surface roughness.

#### Figure captions:

Fig 1 An aluminium structure ready to be treated in order to deposit copper on it by electroforming .

Fig 2 A thin gold layer deposited on an aluminium cylinder by sputtering.

Fig 3 Sample obtained by galvanoplastic procedure. A layer of unknown oxide is on the gold after a treatment with NaOH .

Fig 4 The first tentative to obtain an Electroformed Coupler.

Fig 5 Design of a copper three cells section standing wave.

Fig 6 A three cells copper RF structure under vacuum test.



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