A.13: Copper deposition of Stainless steel Radio Frequency Quadrupole Chamber

As part of the accelerator augmentation program at Inter University Accelerator Centre, New Delhi, a high current injector (HCI) is being developed to inject highly charged ions into the superconducting LINAC. The purpose of the HCI is to deliver higher currents at higher charge state so as to provide higher currents and energies at the final experimental areas. The HCI consists of a superconducting (High TC) ECR source operated on a high voltage deck, producing the high currents of highly charged ions. The ion beams produced by the ECR source will be injected into a Radio Frequency Quadrupole accelerator (RFQ) and be accelerated to 180 keV/u. Because of RF requirements, the inner surface of the chamber has to be coated with copper to minimize power dissipation. Final RFQ will have two copper plated vacuum chambers having total internal dimensions of 2.576 m x 0.65 m x 0.5 m as shown in Fig. A.13 1.

Fig. A.13.1: RFQ chamber for high current injector

Preliminary cleaning of the chambers were carried out to remove oil, grease and buffing compounds adhered to the surface during various stages of fabrication. This include vapor degreasing in trichloroethylene, immersion cleaning in ferrowash- 15 alkaline cleaner and nitric acid - hydrofluoric acid solutions with thorough washing between each step. Masking of the external surfaces that do not require copper coating was protected using chemical resistant polyamide tapes and is shown in Fig. A.13.2.

Fig. A.13.2: Chamber masked with polyamide tape

Stainless steel forms a thin invisible oxide film by reacting with the atmosphere. The resistance to corrosion is due to this ever-present oxide film, but making it a difficult to plate metal. The chambers were cleaned with pumice powder to produce a surface free of water breaks followed by anodic and cathodic cleaning in sulfuric acid using lead electrodes for obtaining an adherent coating. Nickel strike to a thickness of 2 to 3 microns was deposited from a solution containing nickel chloride and hydrochloric acid at a current density of 0.05 A/cm^2.

Copper deposition was carried out from a solution containing copper sulphate and sulfuric acid (current density 0.01 to 0.02 A/cm^2) as shown in Fig. A.13.3. Periodic reversal power supply made by Power supplies Division, RRCAT was used for electrodeposition. A 20 second forward cycle followed by 4 second reverse cycle was maintained through out the plating process to produce a deposit with minimum roughness. Intermittent scrubbing of the deposit was also carried out to avoid growth of rough deposits. Thickness measurements were made using Fisher make PHASCOPE for control of thickness.

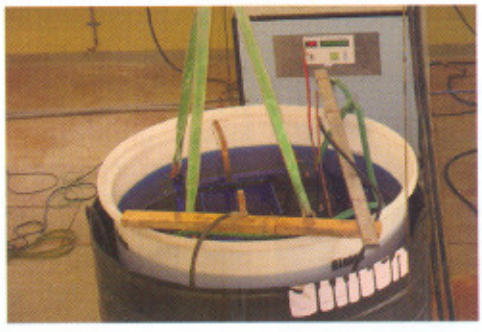

Fig. A.13.3: Electrodeposition of copper using periodic reversal power supply

Electrodeposition of copper was successfully carried out over stainless steel RFQ chambers, end plates and flanges of IUAC to a thickness of 100 microns as shown in Fig. A.13.4.

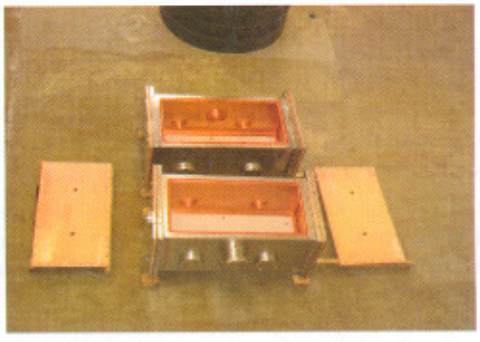

Fig. A.13.4: Copper deposited RFQ chambers

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