L.15: Development of partial pressure brazing facility for joining of high quality components

Brazing forms an important part of fabrication process of many of the key components required for various applications in high technology areas, including accelerator and laser. In such applications, inert gas brazing, vacuum brazing and brazing in hydrogen atmosphere are the main methods adopted. Partial pressure brazing, an important modification of vacuum brazing process, is performed with constant flow of inert gas (usually Ar). The process, besides controlling impurities to a very low level (usually less than 1 ppm), also suppresses evaporation of volatile components of braze metal, thereby maintaining its original composition while ensuring excellent wetting of the substrates by the braze filler.

We report the development of the partial pressure brazing facility at Mechanical Workshop & Glass Blowing Facility (MWGBF) of RRCAT along with test results of brazing of ceramic to metal component. The brazing facility is being geared up to take up joining of components required for RF systems and linac development. The new brazing facility comprises of two different system designs. The first is based on induction heating while the second relies on radiative heating in a water-cooled stainless steel chamber (Figs. L.15.1 & L.15.2).

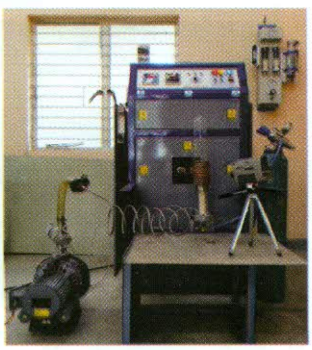

Fig. L.15.1: Partial pressure induction brazing system.

The partial pressure induction brazing system comprises of a quartz bell jar (300 mm long and 50 mm in diameter) integrated with a dry rotary pump and mass flow controller. The induction coupling was provided through a water cooled copper coil, powered by a 30 kW/30 A/20 kHz power supply. The important attributes of this brazing system includes (i) low out-gassing rate and (ii) short brazing cycle important for minimizing brittle intermetallic formation. On the other hand, partial pressure brazing furnace, based on radiative heating, is designed for brazing large jobs under partial pressure of argon, hydrogen or a combination of both. The hot zone of the furnace is 300 mm long with diameter of 300 mm. The heating of the furnace is achieved with super kanthal heater placed inside the chamber. The heater is powered by a 40 V/40 A power supply. The maximum temperature capability of the existing furnace is 900 °C which will be upgraded to facilitate brazing with high temperature fillers.

Fig. L.15.2: Partial pressure brazing furnace.

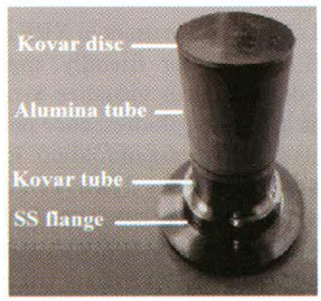

Fig. L.15.3: Al2O3/Kovar component brazed in partial pressure induction furnace.

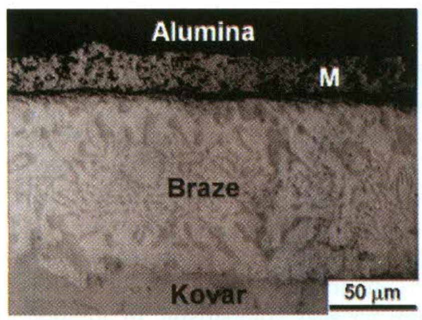

Fig. L.15.4: Cross-section of Al2O3/Kovar joint of brazed component shown in Fig. L.15.3 M-metallized layer.

The new induction brazing system has been used to braze a 20 mm diameter metalized alumina tube to a kovar disc at one end and a kovar tube (welded to a KF25 stainless steel flange) at the other end (Fig. L.15.3). The brazed component exhibited helium leak rate better than 1 x 10-12 mbar.lit/sec. Metallographic examination of the brazed part displayed defect free joint with good bonding of braze metal with two dissimilar parts (Fig. L.15.4).

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