energies the relay after appropriate delay to discharge the energy sensing capacitor through 100 Ω resistance instead of large 1 MΩ resistor. The energy of the laser pulses up to a repetition rate of about 300 Hz can be measured, which is limited by finite operate time of relay.

The effective dynamic range of the energy meter was measured by a Q-switched Nd: YAG laser pulses of about 30 ns operating at the wavelength of 532 nm. The energy measurements were performed over the pulse repetition frequency from a single shot to about 10 Hz. The high frequency operation of the energy meter was limited by the laser. The signal recorded by the photodiode energy meter was plotted as a function of the input laser energy for different values of energy sensing capacitors (Fig L.9.1). The calibration factor for each range was obtained. The energy from the photodiode energy meter can be obtained by recording the peak voltage from the oscilloscope and the calibration factor. The squares in fig. L.9.1 show the plot between the energy recorded by the photodiode energy meter as a function of the input laser energy. The experimental data were fitted to a straight line passing through the origin. The maximum and the minimum detectable laser energy falling on the photodiode energy meter in the linear regime are about 12 μJ and 2 pJ respectively, which correspond to a dynamic range of about 6 × 106. For a given energy sensing capacitor, the error between the measured energy and the fitted value is about ±6% for the energy meter output voltages recorded between 5 and 0.25V.

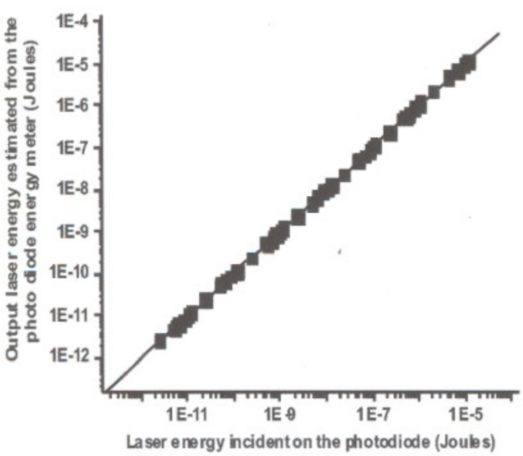

Fig.L.9.1 The graph showing the output of the energy meter as a function of the input energy.

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L.10: Investigation of Glass to Metal Seal on ambient oxidized Kovar surface

Glass to metal (GM) seal is an important component having wide applications in various disciplines of science and engineering. Kovar alloy is the most widely used material for making matched glass to metal seals. Sealing surface of the Kovar must be initially oxidized. This facilitates wetting by molten glass and subsequent chemical bond formation resulting in a strong and vacuum tight glass to metal seal. The nature and thickness of oxide layer is important to produce a high quality glass to metal seal.

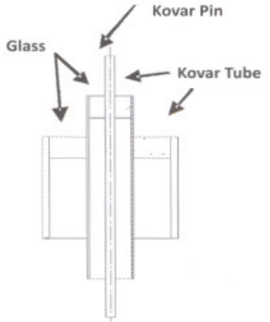

Fig .L.10.1 Coaxial glass to metal feed through with mounting flange

Oxidation of Kovar sample plates was done using LPG flame in ambient condition. The time of oxidation was 5, 20, 30, 50, 60 and 120 seconds. Following the same fabrication cycle a coaxial GM seal was made for capillary discharge system in Laser Plasma Division.

Characterization of the oxidized Kovar sample and GM seal were done as given below:

- X-ray Diffraction (XRD) with CuK_α (1.54°A)
- Optical microscopy
- Scanning Electron Microscopy (SEM) with Energy-Dispersive Spectroscopy (EDS)
- Leak Testing using He leak detector.

The XRD results shown in fig L.10.3 indicated limited oxidation on specimen oxidized for 5 seconds; significant oxidation was seen in all samples oxidized for 20 seconds and more. Further, the oxide layer on Kovar surface comprised of Fe_3O_4 and γ-Fe_2O_3, α-Fe_2O_3 was observed only after 120 seconds of oxidation.

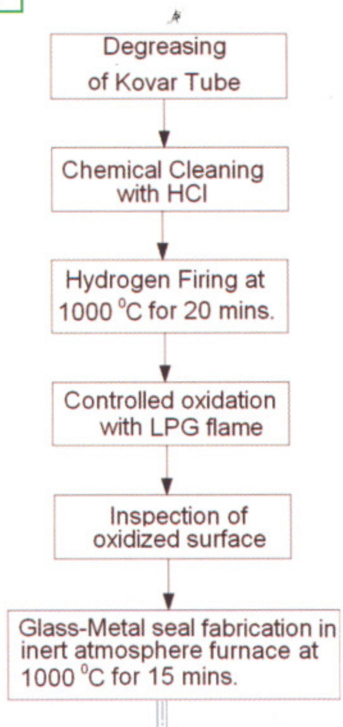

Fig L.10.2 Fabrication of GM Seal

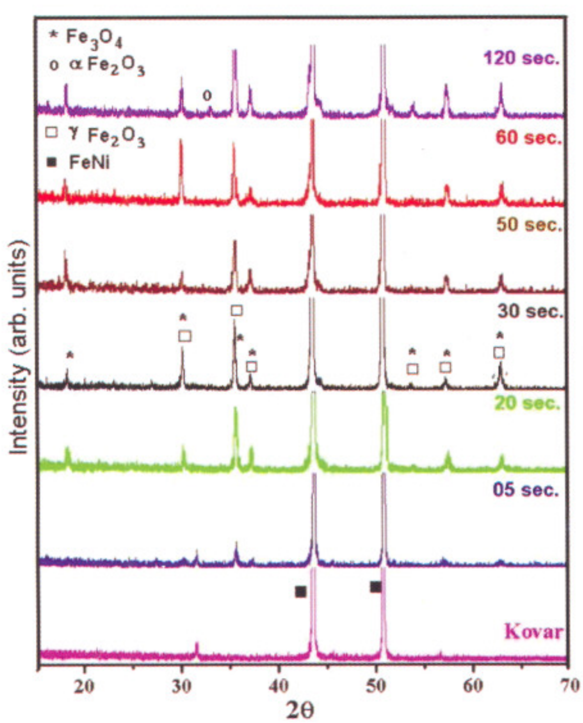

Fig L.10.3 XRD pattern of the various samples

The microscopic examination shown in Fig. L.10.4 revealed no bonding of glass to metal on samples oxidized for only 5 seconds (left) while excellent bonding for samples oxidized for 30 seconds (right).

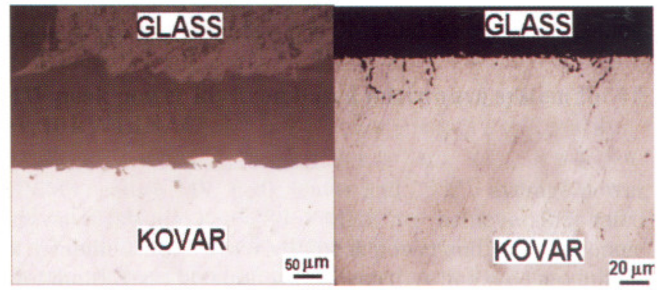

Fig L.10.4 Microscopic evaluation of the seals

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