

Couillaud locking scheme to lock the SLM IR laser to an external resonator.

(Contributed by: TPS Nathan; nathan@cat.ernet.in)

L.14 Hand operated laser manipulator for cutting of coolant channel of feeder coupling bolts in PHWR

Hand operated laser manipulator has been used for cutting operation at Madras Atomic Power Station. One of the major activities during the shut down for preventive maintenance is the replacement of coolant channels. Grayloc coupling based mechanical seal joints are fitted on two ends of the coolant channel and D₂O (inlet and outlet) feeders. For replacing the coolant channels all the joints are to be opened by some mechanical means e.g., powered torque wrench. Due to excessive corrosion and jamming of the bolts, it is expected that it will not be possible to open some of the joints. So, it is needed to cut these bolts. These joints are made up of two of high tensile M16 bolts (fig. L.14.1).



Fig. L.14.1

Industrial Nd:YAG Laser with 250W maximum average power delivered through optical fiber beam is connected to the cutting head mounted on the manipulator. An improvement in cut quality is possible with either pure inert gas or inert-oxygen mixture as assist gas.

(Contributed by: TPS Nathan; nathan@cat.ernet.in)

L.15 Laser cutting tool for steam generator tubes in PHWR

In pressurized heavy water reactor based nuclear power plants, mushroom type steam generators (SG), made up of non-magnetic INCONEL-800 material, and are being used. The SG is a sheet and tube type heat exchanger. The SG tubes with inner diameter 14mm and outer diameter 16mm are mounted in the tube sheet in diamond pattern with tube-to-tube distance 22mm. The tubes are U-shaped and running up to 7-8meter height. Leakages in the SG tubes have been identified at various power plants in the country. To identify the reason of thinning of the tubes and leakage, it is necessary to get the sample of the tube from the location of leakage and investigate the reason behind leakage from SG

tubes, e.g. material problem, local indentation problem, erosion problem etc., by further metallurgical examination. Laser based cutting mechanisms are being developed to take out the lower portion of the tube or cut a small window from inside and take it out from inside of the tube.

An industrial Nd: YAG laser having 250W average output power with fiber optic beam delivery and manipulator has been designed and developed, which will go inside the tube up-to a desired height and will be moved by motorized rotary mechanism mounted on the bottom of tube sheet. A miniature cutting head with outer diameter 13.6mm and 85mm over all length has been developed, so that it can be inserted through 14mm ID SG tube as shown in fig. L.16.1 above. Fig.L.15.1 shows cut quality with oxygen and argon as assist gases.

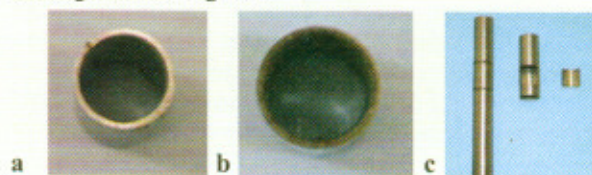


Fig. L.15.1

Many cutting trials for both, circumferential and window cutting were carried out. The debris produced in both the cases had just surface adhesion and apparently no adverse effect on the adjacent tubes.

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L.16 Silicon nano particles with blue – UV photoluminescence

The Si nanostructures have attracted significant attention in the past several years for the photoluminescence studies in the red – green region. Recently oxygen containing silicon fine structures have extended the emission in blue region, which has wider optoelectronic applications. A new technique of generating silicon nanoparticles using an ultra dispersive powder (UDP) has been setup. With the thermal evaporation in controlled and varied atmospheres, silicon particles as fine as ~ 60nm were produced with enhanced PL in Blue-UV region.

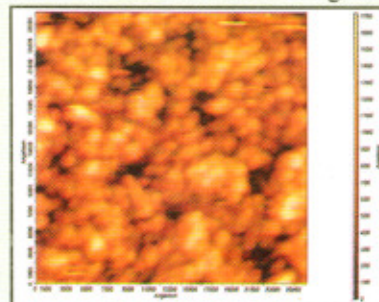


Fig. L.16.1 AFM of Si/SiO₂ crystallites