

## **Effect of CO<sub>2</sub> laser irradiation on the track registration properties of CR-39**

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### **Abstract**

The effect of multiple pulses of a 10.6  $\mu\text{m}$  CO<sub>2</sub> laser with energy 1-3 Joules on the track registration properties of laser induced plasma ions on CR-39 have been studied. CR-39 was exposed by CO<sub>2</sub> laser generated Hydrogen and high energy (400KeV) proton beam from Cock Croft Walton Accelerator. The etched detectors were then exposed for different number of shots of CO<sub>2</sub> Laser. It was observed that at even a single shot of CO<sub>2</sub> laser, irrespective of the ions, can change the track registration properties of CR-39 and can remove the vaporization resistant skin present on the polymer (CR-39). The change in the track diameter, track density and track shaping of different ions was observed significantly

### **Introduction:**

The well defined ablation of polymers induced by irradiation with UV, visible and IR lasers [1-2] is of great technical interest for variety of different areas. When laser interact with polymers, a lot of phenomenon related to photothermal, photochemical, photo mechanical and photo physical processes occur. This can cause depolymerization of polymer into monomers, bond dissociation, photofragmentation, increase in the density of chromophores, cluster formation, plasma production and gas dynamical effects with shock waves. The entire phenomenons are responsible to change the electrical, optical and

mechanical properties of polymers and also cause the change in the surface morphology and track registration properties of polymer. [3-6]

Most of work reported is related with ablation of polymers like PMMA, PI, PET and mica with UV laser. [9-10] but very little work is reported about IR laser irradiation effects specially on track registration properties of CR-39.[11-12]

The author' work deals with the study of change in the track registration properties of CO<sub>2</sub> laser generated Hydrogen, and high energy ~300KeV proton beam from Cock Croft Walton Accelerator on CR-39 after irradiation with multiple pulses of CO<sub>2</sub> laser.

### Experimental Work

The experimental set -up for exposing CR-39 to laser induced plasma ions of hydrogen shown in Figure 1. The detector was exposed to laser induced plasma ions of hydrogen under one atmospheric pressure

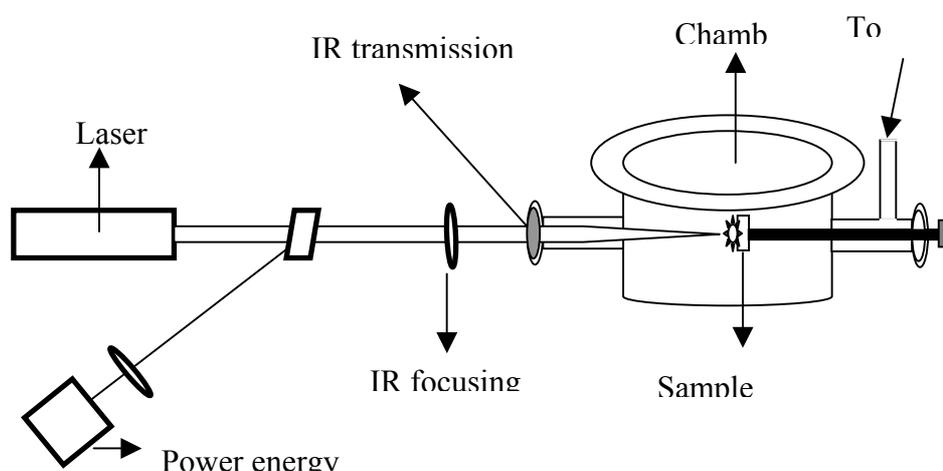


Figure 1: A Schematic of the Experimental Set up for the Exposure of CR-39 to laser generated plasma ions

of CR-39 was Cock Croft Walton Accelerator . A high energy ~400KeV proton beam from this accelerator was used to expose CR-39 under vacuum conditions.

The etched detectors were then exposed by CO<sub>2</sub> laser for different number of shots. The pulsed energy was 2.5J/pulse with pulse duration of 200 nsec. To see

laser irradiation effects on track registration properties of polymer ,it was again observed by optical microscope .

### Results and Discussion

The effect of multiple pulses of 10.6  $\mu\text{m}$  CO<sub>2</sub> laser with energy 1-3 Joules and 200 nsec on the track registration properties of CR-39 has been studied It was observed that at even a single shot of CO<sub>2</sub> laser can change the track registration properties of CR-39 and can remove the vaporization resistant skin present on the polymers. The change in the track diameter, track density and track shaping of hydrogen ions was

observed significantly. Figure 2 shows the laser treated surface of CR-39 after irradiation with the hydrogen ions. Circular tracks have been changed

to hexagonal, elliptical and triangular shapes.

While in figure 3 there are broken chains and wave like ridges formation due to coherent and non-coherent instabilities. Figure 4 shows the laser exposure of proton irradiated

CR-39. there is a presence of circular and regular fringe patterns. The fringe width decreases with decreasing distance from the center due to reduction of laser energy intensity. The CO<sub>2</sub> laser irradiation on CR-39 shows significant change

in the track registration properties of CR-39

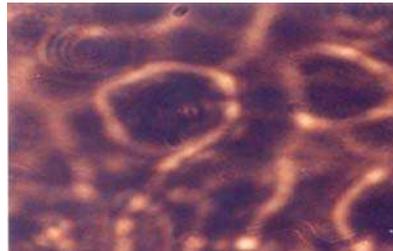


Figure 2: (a) Laser treated surface of CR-39 for reshaping of H<sub>2</sub> ions.

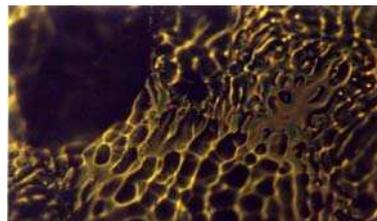


Figure 3: Reshaping of H<sub>2</sub> ions. Broken chains and wave like ridges due to instabilities.



Figure 4 : Diffraction pattern and laser induced periodic structure on CR-39.

in terms of tracks size, track density and shapes due to coherent, noncoherent and hydrodynamical instabilities. These effects may be due to shock waves produced by the high power laser. The depolymerization and fragmentation of monomers from polymer may be attributed to the thermal effect of IR irradiation.

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