Capacitive coupled RF discharge plasma for cleaning of carbon contaminated Optics

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The deposition of carbon layer on optics surfaces due to prolonged use in synchrotron light sources and lasers is a severe problem that reduces the efficiency of the optics dramatically. Low pressure plasma glow discharge has been considered as a cost effective way in the optics cleaning compared to recoating the surfaces. A capacitively coupled RF glow discharge plasma based optics cleaning setup is installed and optimized for carbon contamination removal rate from optics surfaces by varying process parameters like feed power, process gas pressure and exposure time. The removal rate of deposited carbon coating is estimated using x-ray reflectivity measurements (XRR). At low feed power (10 watts) carbon removal rate about 0.6 nm/min at 0.04 mbar argon pressure is observed. The over exposure of optics to plasma damage the reflecting surfaces also. Some optics used in laser applications such as VLS, Compressive Optics and Off Axis Parabola Mirror also cleaned by this system. The integrated reflectivity of these optics is regained from 60% to 95% of the fresh optics. Uncleaned and cleaned VLS grating shown in fig-1. Experimental and theoretical curve of reflectivity for Carbon capped Mo film treated and untreated by RF plasma is shown in fig. 2.

Fig. 1. Integrated reflectivity of compressive grating reduces to 65% at (800±10nm) due to contamination (left). After cleaning at 10 watts and 0.04 mbar Ar pressure integrated reflectivity improve up-to 95% (Right).Reflectivity is measured by calorimetric technique.

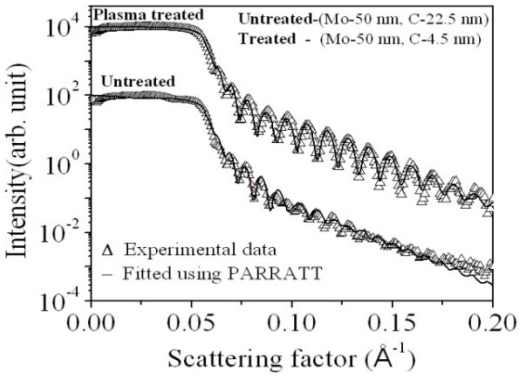

Fig. 2. An experimental and theoretical fitted curve of the samples treated and untreated by RF plasma.