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Determination of argon fluoride (ArF) excimer laser system and its diagnosis on optical materials

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The growing interest in precise fabrication of micro and nano-structures such as optical components, sensors and devices make the conventional approach no longer satisfactory for micro scale structure. Excimer laser ablation is particularly well suited for material such as polymer because of their excellent properties and ablation behavior. The objective of the project is to diagnose the ablation work for optical material. An ArF excimer laser was utilized as a source of energy. As a preliminary work, the laser was calibrated to determine the best performance of the laser beam. Various materials including thermal paper, high-density polyethylene (HDPE), plasticised polyvinyl chloride (PPVC) and polymethyl methacrylate (PMMA) material were employed as an ablating target. Each specimen was ablated with excimer laser which was operated at various parameter comprising of working distance, high voltage, repetition rate and number of pulses. The ablated materials were analysed by using Matrox Inspector 2.1, Video Test 5.0 and Ms Excel software. The changes in the refractive index of PMMA sample were analysed using Brewster angle. The results obtained showed that the ablation on these materials depended on working distance. A short working distance offered the best performance for ablation which was 30 cm, since less energy were lost during the propagation. The ablation work also depended on the high voltage in the range of 13 kV – 14kV, suitable for ablation process. The ablation work was also found to be independent with the repetition rate of the laser. Finally, the ablation was found sharply increased with respect to the number of pulses. The best performance for this study was found at 400 pulses. Two of the tested materials, PPVC and PMMA demonstrated good performance for the ablation work. The 3D image analysis, offer an estimation of depth of the ablation spot area. The refractive index of PMMA decreased from 1.46 to 1.23 in the range of 200 to 500 pulses.