

## **Abstract**

In this work, the CO<sub>2</sub> laser was used for engraving on PMMA, Redwood, and Gypsum board samples. The effect of laser engraving process parameters on material surface characteristics were studied for each material.

The experimental procedure of laser engraving is done using a CNC CO<sub>2</sub> laser machine with 10.6  $\mu\text{m}$  wavelength and output power range from 1-70W. Taguchi method is used to design the experiment and to optimize the effect of the process parameters on the material surface. Also, the Grey relational analysis (GRA) method is used for selecting the best process parameters which will give the best characteristic. The Taguchi optimization result shows that, The engraving depth increases with increasing the laser beam power and it was increased with decreasing both the scanning speed and the overlapping. Also, the overall time of engraving increased with decreasing the speed and overlapping space, but it have constant relation with the power. The surface roughness for PMMA increased with increasing the laser beam power and the scanning speed.

The GRA method shows that the best response (surface roughness, depth, overall time) with engraving parameters (laser power, engraving speed, overlapping space) for PMMA is 40W, 100 mm/min, and 0.05 mm which have 4.6mm depth, 1.72 $\mu\text{m}$  roughness, and at 40.22min characteristics. While, for the redwood is 40W, 100 mm/min, and 0.3 mm which has 2.25mm depth and at 6.95min characteristics. Finally, for Gypsum board is 65 w, 500 mm/min, and 0.03 mm have 0.5mm depth and 6.23min time.