

Rapid Direct Continuous Method for Hot Embossing of Glass Microlens Array Combined with CO₂ Laser Irradiation and External Preheating/Cooling

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ABSTRACT

Hot embossing of glass micro structures requires long thermal cycle, generally takes no less than 15 min due to the isothermal heating, pressing and cooling performed inside a closed vacuum chamber. In this paper, a new hot embossing procedure was presented. First, the glass was preheated slightly below its glass transition temperature at the heating station. Then, a thin layer of the glass surface was further raised to high temperature temporarily through CO₂ laser irradiation. The glass was then quickly transferred to the embossing station for pattern transfer, demolding and followed by external cooling. This method accelerated the filling of glass material into the microlens array mold cavities and outperforms the conventional method in terms of overall cycle time reduction, lower mold working temperature and embossing pressure. Microlens array with diameter of 135 μm , sag height of 18.5 μm and pitch of 200 μm were faithfully embossed onto the K-PG375 optical glass time in a time scale of about ~ 3 s. Optical evaluation of the glass MLA was also performed using charge couple device (CCD) camera which showed uniform spot intensity.

KEYWORDS: CO₂ laser, Micro lens array, Hot embossing, Optical glass

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