Precision Engineering 47 (2017) 469–479

Contents lists available at ScienceDirect

Precision Engineering

journal homepage: www.elsevier.com/locate/precision

Improvement of form accuracy and surface integrity of Si-HDPE hybrid micro-lens arrays in press molding

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ARTICLE INFO

Article history:
Received 24 May 2016
Received in revised form
12 September 2016
Accepted 30 September 2016
Available online 15 October 2016

Keywords:
Hybrid optics
Lens array
Infrared lens
Press molding
Microstructure

ABSTRACT

Press molding of silicon (Si)/high-density polyethylene (HDPE) composite is an important technology for producing thin hybrid infrared (IR) optics with microstructures. In this research, Si-HDPE hybrid micro-lens arrays were press molded under various conditions, and the form accuracy and surface integrity of the molded lenses were evaluated. Air trapping occurs inside the micro-lens cavities during molding in a non-vacuum environment, which leads to severe surface defects. To investigate the air trapping phenomenon, a new in-situ observation system was developed which enables real-time direct observation of the molding process. From the in-situ observations, it was found that air traps were formed among the HDPE pellets during melting, and an increase in the pressing force will increase the pressure of the trapped air, forming trenches on the lens surface. The trapped air also impacts the mold coating, causing trench formation on the coating surface. To minimize air trapping, the molding temperature, and pressing force must be strictly controlled. By performing press molding in a vacuum environment, trench formation was completely eliminated. Moreover, polymer shrinkage compensation was performed to improve the lens form accuracy.

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http://dx.doi.org/10.1016/j.precisioneng.2016.10.002
0141-6359/