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Simulation of Laser Structuring by Three Dimensional Heat Transfer Model

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Abstract : In this study, a three dimensional numerical heat transfer model has been used to simulate the laser structuring of polymer substrate material in the Three-Dimensional Molded Interconnect Device (3D MID) which is used in the advanced multi-functional applications. A finite element method (FEM) transient thermal analysis is performed using APDL (ANSYS Parametric Design Language) provided by ANSYS. In this model, the effect of surface heat source was modeled with Gaussian distribution, also the effect of the mixed boundary conditions which consist of convection and radiation heat transfers have been considered in this analysis. The model provides a full description of the temperature distribution, as well as calculates the depth and the width of the groove upon material removal at different set of laser parameters such as laser power and laser speed. This study also includes the experimental procedure to study the effect of laser parameters on the depth and width of the removal groove metal as verification to the modeled results. Good agreement between the experimental and the model results is achieved for a wide range of laser powers. It is found that the quality of the laser structure process is affected by the laser scan speed and laser power. For a high laser structured quality, it is suggested to use laser with high speed and moderate to high laser power.

Keywords : laser structuring, simulation, finite element analysis, thermal modeling
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