

*2007 MAE Departmental Seminar Series*

**Modeling of Laser Drilling Considering Multiple Reflection of  
Laser, Evaporation and Melt Flow**

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Laser drilling was analyzed by considering multiple reflections and evaporation of material. In the keyhole formation process, the variation of the hole shape and the variation of the absorption of the laser power distribution in the wall were examined. The flow velocity distribution of the molten metal was also examined. Moreover, the effect of material on the hole shape was examined. The main results obtained are as follows: (1) At the stage where the depth of the hole is comparatively shallow, the power at the bottom of hole increases by the effect of multiple reflection. (2) When the hole becomes deep, the effect of multiple reflections becomes remarkable and the absorption factor increases. The absorptance increases due to multiple reflections to a value of about 0.75. (3) When the hole becomes deep, the flow field shows circulation of molten metal that rises near the walls of the keyhole and by surface tension, moves away from the keyhole at the surface, forming an eddy. (4) Because the thermal diffusivity of aluminum is larger than iron, the energy lost by thermal diffusivity increases, and the energy used to evaporate decreases. Therefore, in case of aluminum, the molten pool broadens and the hole becomes narrow.

Dr. Etsuji Ohmura is an Associate Professor in the Department of Materials and Manufacturing Science at Osaka University. He received a Bachelor of Engineering in 1976 and a Doctor of Engineering in 1984, both from the Department of Precision Engineering, Osaka University. His main field of research is intelligent laser processing systems, using theoretical analysis and computer simulation to gain a deeper understanding of complicated physical phenomena in laser material processing, the influence of laser optics, and nonlinear optical phenomena. He is a member of the LIA, the Japan Society of Mechanical Engineering (JSME), the Japan Society of Precision Engineering (JSPE), and the Japan Laser Processing Society (JLPS). He has been Editor-in-Chief for the Journal of JLPS since 2000 and on the organizing committees or the steering committees for several international and Japanese technical conferences, such as the International Symposium on Laser Precision Microfabrication (LPM), the International Conference on Leading Edge Manufacturing in 21st Century (LEM21), and annual meetings of JSME. He has been on the LIA Board of Directors since 2005.