Laser Manufacturing Laboratory
LML
University of California, Berkeley

Theoretical Model of the Laser Cutting Process

Principal Investigators: Paul Sheng and Li-hong Cai

This project seeks to develop a comprehensive process model for laser cutting. The main effects which influence material removal during laser cutting are illustrated in Figure 1. First, the incident laser beam is partially absorbed by plasma above the cutting front (for fusion cutting of metals). The surface of the cutting front also reflects a portion of the beam energy. The remaining incident beam energy is balanced by the effects of heat conduction into the bulk of the workpiece and phase change (either melting or vaporization) at the cutting front surface. This phase change propagates the kerf and results in material removal. Other factors include convection inside the molten layer, convection from the flow of the gas jet inside the kerf, and secondary reflections of beam energy from the kerf walls.

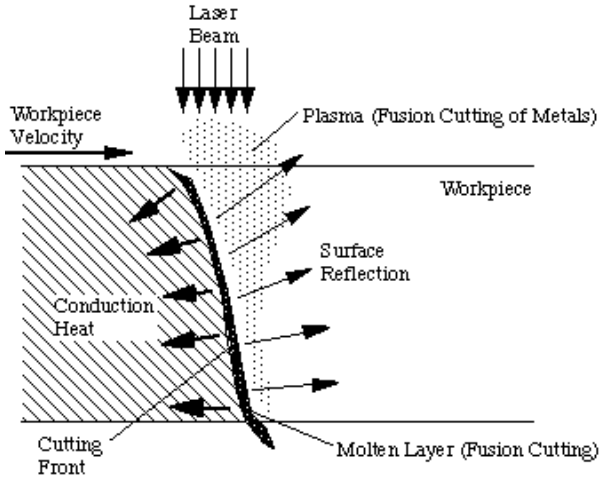


Figure 1: Main Effects During Laser Cutting

The three-dimensional shape of the cutting front can be estimated for different conditions of beam power and workpiece velocity, accounting for heat conduction, surface absorptivity, plasma absorption and phase change effects (Figure 2).

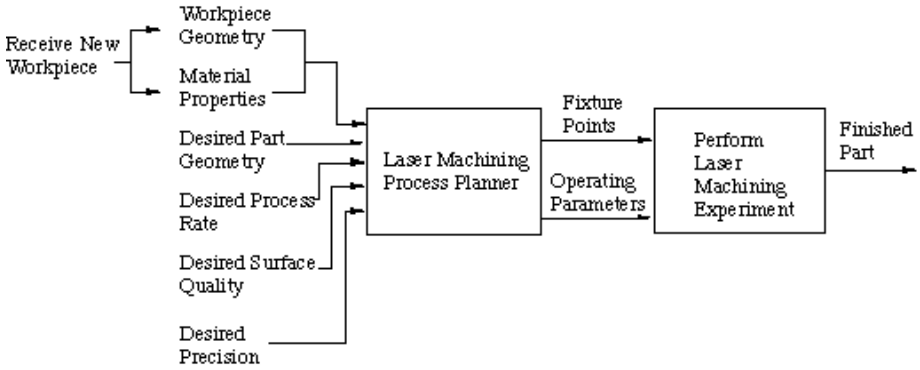
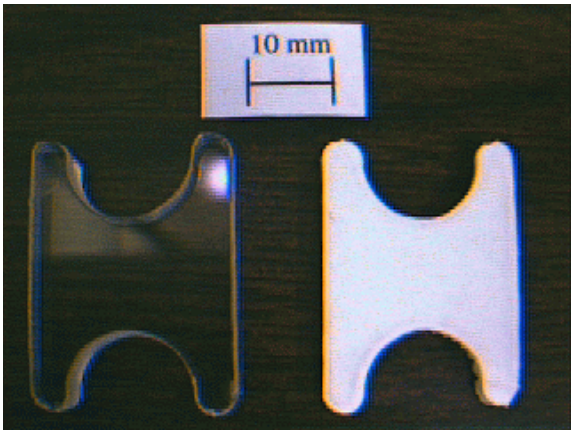


Figure 2: A Process Planning Approach to Laser Machining

Cutting samples for PMMA and Ceramic are shown in Figure 3.


10 mm