

**ANALYSIS OF HEAT TRANSFER IN SUBCOOLED METAL POWDER
SUBJECTED TO PULSED LASER HEATING**

Chad Konrad

Dr. Yuwen Zhang, Thesis Supervisor

ABSTRACT

The interaction of metal powder and pulsed laser heat flux is investigated on two levels, the powder bed level and the particle level. The locations of the thermal penetration depth and the liquid-solid interface are obtained using the integral approximate method. Melting and resolidification of a subcooled, two-component metal powder bed subjected to temporal Gaussian heat flux is investigated analytically. An increase in heat source intensity or powder bed porosity will result in an increase of the melt pool depth, melt pool temperature, and the overall processing time. The melt pool becomes shallower with increasing subcooling. Heat conduction in a single subcooled metal powder particle subjected to nanosecond pulsed laser heating is also investigated analytically. A change in the repetition rate of the laser or an increase in maximum heat flux will result in a larger temperature rise on the surface of the particle, as well as a higher thermalized particle temperature after the laser pulse is finished. Although a discrepancy exists where peak surface temperatures are concerned, the thermalized temperatures of different-sized spheres are all the same. The time at which the particle is fully penetrated is only affected by a change in thermal diffusivity, laser pulse width, or particle radius. The physical model and results of this investigation pave the way for further modeling of Selective Laser Sintering (SLS) processes with a pulsed laser.