Public Abstract

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Title: AN AXISYMMETRIC INTERFACIAL TRACKING MODEL FOR MELTING-VAPORIZATION-RESOLIDIFICATION IN A THIN METAL FILM IRRADIATED BY PICO TO FEMTOSECOND PULSE LASERS

Laser metal interaction phenomenon has been studied for years and many pioneers in this field have proposed different kinds of analytical, computational and experimental models to get very precise results of heat transport and associated phenomenon. The phenomenon experienced by the FEMTOSECOND LASERS when interacts with various materials are very different. A model has been developed to analyze preheating, melting, vaporization and re-solidification in metals when ultrashort (femtosecond) pulse lasers interacts with them.

Existing one dimensional model have limited application due to the assumption of the film thickness much lower than the characteristic radius of the laser beam. The primary objective of this work is to develop an axisymmetric (multi dimensional) model to track various phenomenon occurring in the metal when irradiated by an ultrashort pulsed laser while considering the thickness of the metal/material to be significantly large for considering an axisymmetric heat transport effect. To achieve the above stated task and develop the model, the following major steps have been taken. Firstly, derive the appropriate mathematical relations and discretize them so they may be solved using the finite volume method. Secondly, define the appropriate boundary conditions and reasonable assumptions made for the computational and programming ease. Third, apply a heat flux equivalent to the energy transferred by laser. The whole process, including simulation was aided by the computational methods. The concept was first converted to a computer code in (FORTRAN programming language) by appropriate iteration procedure explained in the consecutive sections. Several steps have been carefully taken in order to verify the accuracy of the code and results obtained. Some of the measures to check the validity of the code are to verify the results obtained from the work obtained from previous works in one and two dimensional problems by either changing the applied flux so as to simulate the axisymmetric domain as multiple one dimensional problems that have been already solved and approved.