Effect of laser beam incident angle on the absorption coefficient for graphite-coated surfaces

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ABSTRACT

This work presents an experimental-numerical methodology aimed at describing the effect of laser beam incident angle in the absorption coefficient for graphite-coated surfaces. The main motivation is to determine the dependence degree of the value of the absorption coefficient required for the thermo-mechanical simulation of laser bending on the incident angle and, in addition, to estimate the corresponding values for different angles.

To this end, temperature measurements using K-type thermocouples are performed on a sheet during the irradiation of a certain laser power and incident angle. Then, the absorption coefficient values are obtained by minimizing the error between temperature evolution measurements at various locations of the irradiated sheet and the corresponding finite element predictions for that incident angle. The procedure is repeated for several angles and a trend is established. Numerical results and experimental measurements are compared and discussed.

The importance of this work lies in the fact that the use of erroneous values of the absorption coefficient in the numerical simulations leads to significant deviations from the experimental measurements. Analysis of the influence on error propagation of uncertainties in laser forming showed that variations in power and absorption coefficient are the most influential factors on the numerical results [1]. Moreover, the absorption coefficient of materials found in real-world applications differ greatly from the values reported for pure materials [2]. Therefore, for situations in which the laser is non-perpendicular to the work piece, it is important to determine its value for each experimental situation.

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