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Understanding the behaviour of pulsed laser dry and wetmicromach ining processes by multi-phase smoothed particle hydrodynamics (SPH) modelling

Abstract

A smoothed particle hydrodynamics (SPH) numerical model is developed to simulate the three-phaselaser micro-machining process for medical coronary stent manufacture. The open-source code SPHysics is used to model the interaction between the laser beam and workpiece. This enables the melt flowbehaviour in the non-linear pulsed fibre laser micro-machining process to be modelled. The developed model considers the conversion of laser energy into heat within a very thin surface layer, heat conduction into the parent material and the phase transition between solid, liquid and vapour. A good agreement with experimental data is obtained for predicting the penetration depth and melt ejection velocity. Water is also incorporated in this model to help explain the mechanism in laser wet micro-machining and drilling. It is demonstrated that the meshless characteristics of SPH are able to model the droplets ejected from kerf where it is difficult for conventional modelling. A static beam was used throughout the model development.

Keywords

Smoothed particle hydrodynamics (SPH); Micromachining; Coronary stents