Multi scale model of the laser dieless drawing process of tubes from hardly deformable magnesium alloys

Abstract

Micro tubes made from magnesium alloys are used in various fields such as medical, electrical, electro-mechanical systems and chemical industry. The proposed project is dedicated to the physical and numerical modeling of laser dieless drawing of micro tubes from low ductile magnesium alloys. Benefits of laser dieless drawing in comparison with conventional drawing are the ability to draw low formable materials and the possibility to produce variable cross-section tube. The process of laser dieless drawing uses a controlled laser beam as a local heat source. By controlling the parameters of the beam is possible to produce small-diameter tubes from low-plastic alloys of magnesium. The development of heating and deformation parameters of laser dieless drawing requires analysis of tensile speed of the billet, parameters and the localization of heating, etc. These factors will effect on the bulk forming of the billet, the possibility of its damage, the mechanical properties of the tube (in macro scale), relief of free surface and the possibility of micro cracks at grain boundaries (meso scale).The experimental solving of this problem is difficult. The overall aim of the project is to develop the numerical multi-scale model which allows carrying out multi-criteria optimization of laser dieless drawing process. The model will be implemented as a program which will use parallel and distributed computations on high performance computers what allows quick finding of the optimal variant of the process parameters on the basis of simulation. Model in macro scale will predict the bulk metal forming, temperature and damage parameters. Meso scale model will predict the presence of defects in metal and relief of free surface. Development of a model of the materials will be made on the basis of a number of plastometric tests of magnesium alloys under conditions which are typical for laser die less drawing. The project relevance regarding the aim of the Joint Call in terms of Lightweight construction materials and Materials for electronics and energy harvesting, laser technologies.

Project on www.researchgate.net:

<https://www.researchgate.net/project/Multi-scale-model-of-the-laser-dieless-drawing-process-of-tubes-from-hardly-deformable-magnesium-alloys>

Deliverable D.1.2 [Downloadable version of the program for PC](FEM_programs_for_download)

Deliverable D.1.1 [Parameters of material models for magnesium alloys AZ31, ZEK100, AX30, MgCa08 (in report and web page)](MaterialModels)

[Microstructure in samples after tension tests](MicrostructureForMezoScaleModel);

[Distribution of strain in sample during tensile test](Distribution%20of%20strain%20in%20sample%20during%20tensile%20test).

[Model of fracture along grains boundaries](Model%20of%20fracture%20along%20grains%20boundaries).