Bachelor / Master thesis

Effect of tool geometry on the microstructure of rods processed by the novel Constrained Friction Processing

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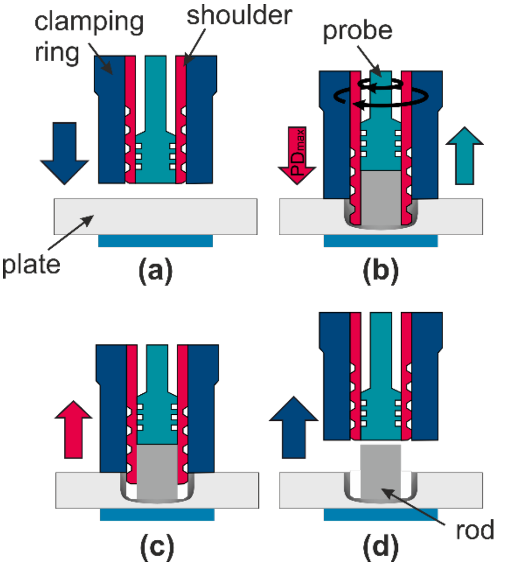
Introduction

Mg alloys are interesting lightweight materials with properties such as high strength per weight ratio and biocompability. For this reason, magnesium alloys are attractive candidates for a range of applications such as structural and biomedical components. Constrained Friction Processing (CFP) is a novel thermo-mechanical technique to produce extruded fine-grained microstructure in lightweight materials. The method has the potential to overcome processing challenges of Mg alloys, attributed to the low formability and ductility at room temperature due to the hexagonal closed-packed structure. Furthermore, CFP can be applied for tailoring the distribution of grain sizes in Mg alloys and enhancing grain-size dependent properties, with some advantages such as no preheating required, short processing time and simple setup. The CFP set of tools – clamping ring, shoulder and probe – are a key factor for the rods' development, since the friction between tool and material is responsible for the heat input and material flow. Therefore, the shoulder geometry is expected to directly affect the developed microstructure and mechanical properties.

Macrograph of representative CFP rod

The aim of the work is to investigate the effect of a new shoulder geometry on the material flow, heat input and, consequently, on the microstructure of rods processed by CFP.



CFP: (a) clamping of the plate, (b) tool rotation and plunging, (c) tool stoppage and shoulder retraction and (d) releasing steps

Tasks

- Literature research (friction-based welding/processing of Mg alloys, severe plastic deformation-based processing of Mg alloys).
- Design and execution of experiments for parameters optimization including processing of AM50 rods, microscopy examination, thermal cycle data acquisition and microhardness testing.
- Presentation of results and documentation of experimental work in English.

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