IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Fatigue Characteristics ofFriction Stir Processed Magnesium Alloy**	
Project Number	**IMURA0935**	
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Research Clusters: 1

Research Themes: 1

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one**. For more information, see www.iitbmonash.org)*		**Highlight which of the Academy's Theme(s) this project will address?** *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*	
1	*Material Science/Engineering (including Nano, Metallurgy)*	***1***	*Advanced computational engineering, simulation and manufacture*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*	2	*Infrastructure Engineering*
3	*Math, CFD, Modelling, Manufacturing*	3	*Clean Energy*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*	4	*Water*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*	5	*Nanotechnology*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*	6	*Biotechnology and Stem Cell Research*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*	7	*Humanities and social sciences*
8	*HSS, Design, Management*	8	Design

The research problem

Magnesium is a lightweight metal, which makes it a potential candidate for automotive industry. Similarly, the superior biocompatibility of Magnesium makes it very useful towards biomedical implants. However, relatively common Magnesiumalloys suffer from low ductility, relatively poor fatigue properties and corrosion resistance. Automotive components and biomedical implants are subjected to cyclic loading, which may lower the life-span of Magnesium components. Friction stir processing is a thermo-mechanical process, which leads to grain refinement due to severe plastic deformation. Previous studies have shown that friction stir processing can be used to refine the grain sizeof various Magnesium alloys, towards enhancement of mechanical properties. Friction stir processing parameters can be varied to control the extent of grain refinement. Therefore it is desirable to understand the influence of frictions stir processing parameters on the resulting fatigue characteristics of the Magnesium alloys. The objective of this work is twofold. First, to map the extent of grain refinement to the friction stir processing parameters, for Magnesium alloy. Secondly, to correlate the grain refinement/size to the fatigue characteristics of processed Magnesium alloy. This will enable the prediction of the fatigue behaviour of the processed Magnesium alloy with respect to the friction stir processing parameters.

Project aims

The aims of this project are:

1. To determine the effects of FSP parameters(rotational rate and traverse speed) on the resulting microstructure (particularlygrain size) and crystallographic texture of the Magnesium alloy.
2. To model the effect of FSP parameters on the strain, strain rate and temperature during FSP of Magnesium alloy.
3. To experimentally validate the thermal response during FSP and map the strain rate-temperature to the microstructural characteristics.
4. To develop correlations between the microstructural characteristics and fatigue properties.
5. To integrate the correlations with the process model, to predict the fatigue behaviour of the processed Magnesium ally.

Expected outcomes

The outcomes of this project are:

1. Structure-property relation between microstructural characteristics and fatigue properties of Magnesium alloy.
2. A simulation method for predicting the fatigue characteristics of friction stir process Magnesium alloy.
3. Friction stir process parameter selection strategy towards desired fatigue properties of Magnesium alloy.

How will the project address the Goals of the above Themes?

Material processing to achieve improved performance is an important aspect of modern manufacturing. Magnesium has high potential towards light-weighting and biomedical applications. However relatively poor fatigue characteristics of Magnesium limits it utilization. This project addresses the challenge by investigating the utility of friction stir processing as a material processing technique to enhance the fatigue characteristics of the Magnesium alloy. This justifies the manufacturing theme.In order to predict the fatigue behaviour of the processed Magnesium alloy, computational methods/simulations will be developed. This justifies the advanced computational engineering and simulation themes.

Capabilities and Degrees Required

Computational skills, MATLAB, Microstructural characterization, Mechanical testing

Potential Collaborators

Professor Ralph Abrahams from Monash University