Functional Surfaces in the Micro-rolling Process, PSED Cluster 2013-2014

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RESEARCH OBJECTIVE

Fabrication of micro feature on material surface has been found the effectiveness in improving tribological performance of tools and dies. The surface micro feature provides cavities for lubrication to reduce workpiece-tool interfacial friction. As a result, wear can be reduced and the tool lifetime can be lengthened. Surface texture also makes contributions in energy generation and conservation. Textures on heat exchangers increases the heat transfer rate so that higher electricity generation rate can be achieved. Textures on algae farms also promotes the growth rate of algae to speed up biofuel generation. Adding textures on car bodies and engine pistons can reduce fuel consumption due to drag and friction reductions. In medical fields, implants with textures has better cell attachment. Moreover, modification of surface roughness can alter or add functions to surfaces to create so called multifunctional surface. One of the surface functions is the ability of water repelling. This refers to the "hydrophobicity" of surface. In order to increase the texturing effectiveness and efficiency, electrically-assisted microrolling-based texturing is applied. Current is introduced to the process and metal is softened by the Joule heating effect. As a result, deeper channel can be produced.

The process in this project used an oil-based PAO lubricant with a special additive that is designed to release graphitic solid lubrication during the rolling process, applying additional lubrication at the site of the contact and reducing wear on the roller. The additive is a surface-active molecule that is functionalized with a densely-packed meta-stable carbon

ACCOMPLISHMENT

- **Hydrophobic effect on Mic**
Textured surfaces showed hi
surfaces, and deeper channels
aspect ratio of channel gives high
liquid-solid-air interface. Dimple-like structures due to pile-up on pillar-tops improves surface hydrophobicity because of the superimposition of micro features. (Tests done on Laser-Induced Plasma Micro-Machined samples)

- **Model for Textured Channel Depth prediction in Electrically-assisted texture**

In electrically-assisted (EA) form
set flowing in the heating zone
as well as softens material. Th
the Joule heating temperatur
experimental data from conv
contact area is corrected. The
depth prediction for the EA mic