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Surface interactions and tribochemistry in boundary lubrication of hypereutectic Al-Si alloys

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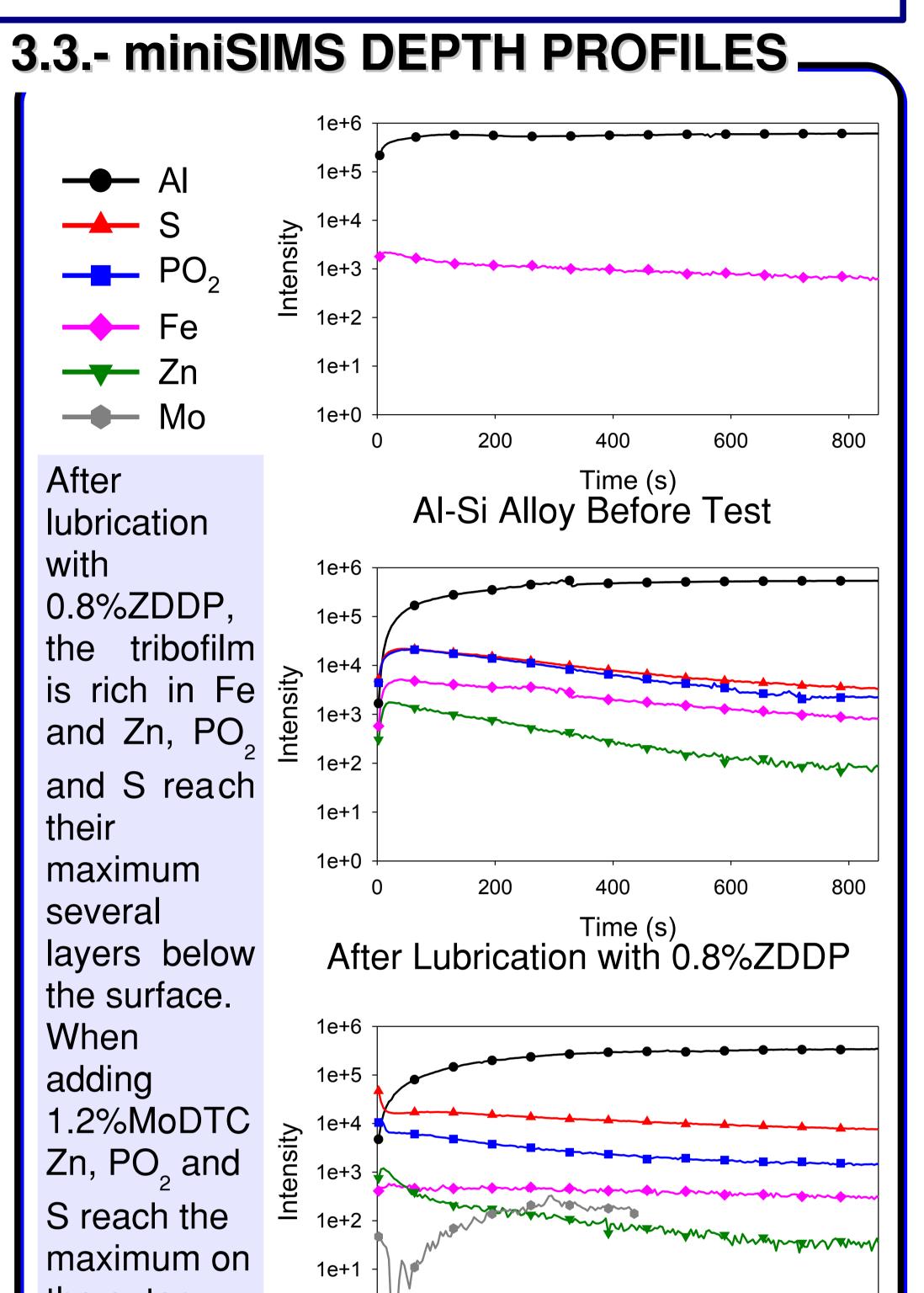
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1.- INTRODUCTION

Al-Si alloys are characterized with a range of properties which make potential materials them to substitute cast iron in automotive The formation engines. OŤ polyphosphate films on AI-Si alloys would indicate the potential use of ZDDP in Iubrication of these alloys and hence facilitate their use as replacement materials for cast iron. It has been shown that the addition of MoDTC assists ZDDP to reduce friction and wear of hypereutectic Al-Si alloys. The aim of the current work is to fully characterize these two different kinds of tribofilms formed on the Al-Si alloy, showing the different surface interactions as a function of the presence of MoDTC in the tribofilm formation, as well as the different distribution and properties of mechanical the tribofilm.

3.- RESULTS AND DISCUSSION

3.1.- TOPOGRAPHY Si Grain Al Matrix



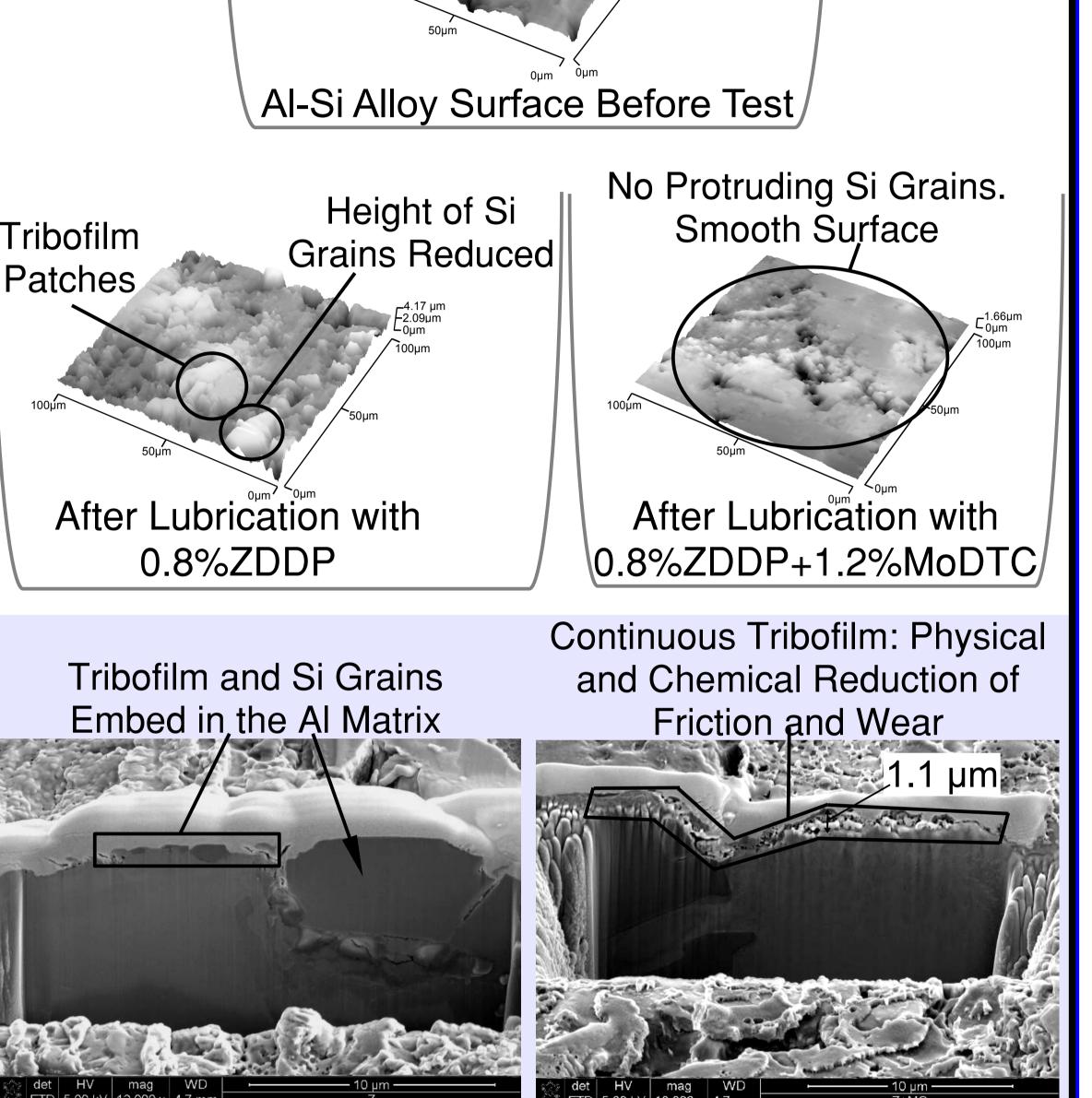
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800

10 12 14 16

2.- EXPERIMENTAL

ubricante



Lubric	cants	Cross Section of Sample Cross Section of Sample Later
	Bal. Bal.	Lubricated with 0.8%ZDDP Lubricated with 0.8%ZDDP 1.2%MoDTC of the 0 200 400 600 Time (s)
	10% 10%	3.2 SEM AND EDS ELEMENT MAPPING Samples. After Lubrication with 0.8%ZDDP+1.2%MoDTC
	0.8%	
MoDTC	1.2%	3.4 NANOMECHANICAL PROP.
Test Ma	terials	Al Simon Same
Pins AISI &	52100 steel	
Plates Hypereut	ectic Al-Si alloy	Hardness (GPa)
Test Con		Al-Si Alloy Before Test 200 After Lubrication with 0.8%ZDDP
Normal Load		$\bullet \text{ Al matrix} \qquad \qquad$
	essure 152 MPa	 Si grains Tribofilm A Tribofilm A
Average Linear S	• • • • • • • • • • • • • • • • • • •	
Test Duratio		The second se
Temperature		
TE 77 Tri	bometer	Mo. Zn P
Technique	Use for	Mo follows the No Zn is present $25 - 4 - 6 - 8 - 10 - 12 - 14 - 16 - 18$
AFM Topometrix		sliding direction After Lubrication with 0.8%ZDDP+1.2%MoDTC With 0.8%ZDDP+1.2%MoDTC
EXPLORER™	Morphology and Topography	
Hitachi S3500N	ropograpny	4 CONCLUSIONS AND ACKNOWLEDGEMENTS
SEM and EDX	Surface Chemical	× With only ZDDP, a decrease of the height of the Si grains can be observed. FIB cross section shows a trib
Millibrook miniSIMS	Analysis	containing Si particles embed into the AI matrix, due to the higher hardness of the Si particles. X The addition of MoDTC gives a smoother surface on the AI-Si sample. FIB cross sections shows a tribofilm coverin
FEI Nova 200	Tribofilm Cross	whole alloy surface, reducing physically and chemically the friction and wear. X When using 0.8%ZDDP, the top layer is mainly composed of Fe, Zn, and a mixture of sulphides and phosphates. W
NanoLab SEM/FIB	Section	adding MoDTC, this top layer is mainly formed of phosphates and sulphides.
Nanotoot Suctom	Mechanical	x Nanoindentations results from the 0.8%ZDDP+1.2%MoDTC lubricated samples show the presence of two tribo harder and softer than the AI matrix respectively.
Nanotest System	Properties	We thank MEC (Spain), EU FEDER (MAT2005-00067, MAT2008-01670) and Castrol Technology Center (UK).



