SEVERE DEFORMATION OF PEARLITIC STEEL DURING MICROSCALE TRIBOLOGY

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ABSTRACT
Tribology at the macroscale is the collective interaction of micrometer asperities as well as the evolution of microstructures below the surface. Wear resistant surfaces depend on an understanding of these evolution mechanisms and on developing tailored surface layers and microstructures.

This contribution starts with a comparison of macroscale and microscale tribology. In this study, we investigate the severe microscale deformation mechanisms of pearlitic steel, i.e. the ferrite and cementite composite, during single stroke wear experiments. We perform microtribology experiments using a diamond indenter and observe severe irreversible cementite deformation strains on the order of tens of percent. We detail the multiple deformation mechanisms and compare them to the observations from literature [1,2]. Additionally, we use microcantilever experiments with and without a pre-crack to understand the origin of the ductile cementite deformation (see Fig. 1). The samples without pre-cracks are used to determine the amount of irreversible deformation in the absence of ferrite support. We will close with a discussion of the temperature evolution in the microscale contact and the discussion of cementite ductility. As such, we argue about the mechanisms that result severe microscale deformation in pearlite.

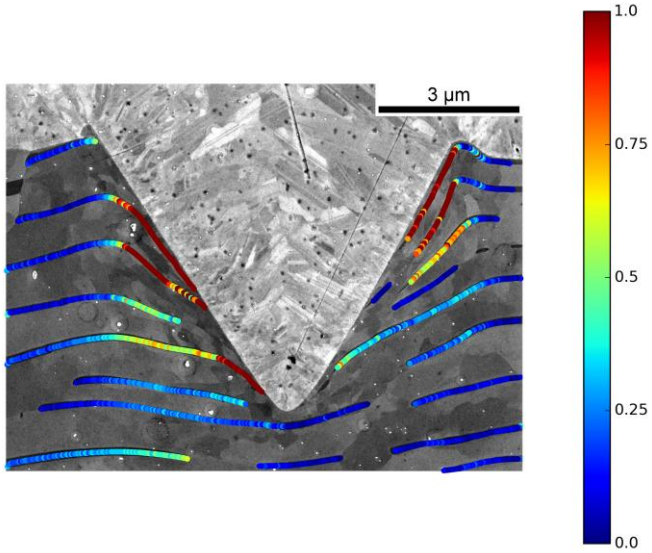

Fig.1 SEM image of cross-section after microscale tribology with superimposed shear strain distribution in cementite lamellae

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REFERENCES
[1] Langford, G. *Metallurgical Transactions A* 8.6 1977, 861-875.
[2] Umemoto, M., Todaka, Y., & Tsuchiya, K. *Materials Science Forum* 426, 2003, 859-864.