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SEM analyses after FIB preparation of the subsurface layer zone of steel balls modified by wear

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Abstract

Surface durability is an important performance factor of tribological contacts and bearings. A primary step in the investigation on steel tribological surfaces is the characterization of subsurface microstructural alterations that occurs as a consequence of thermo-mechanical contact, such as deformation, cracking, phase transformation and oxidation. Sometimes, the scale of the occurring alterations is very small; in this case, advanced techniques of material analysis are required. In the last decade, focused ion beam (FIB) is being a very powerful technique for subsurface characterization in micrometer scale [1]. FIB sample preparation may also be used for site-specific thinning of surface sections with minimal specimen damage.

The current study presents scanning electron microscopy (SEM) analyses after FIB preparation of the subsurface worn regions of AISI 52100 steel balls of ¼ inch diameter size subjected to a four ball sliding wear test in oil-lubricated bath at three different temperatures (60C, 100C and 150C), applied loads of 10kg and 15kg and a rotational speed of 1500 rpm, up to a 30 min time. The subsurface stress affected zones of the balls resulting from the tests were precisely determined, as shown in Fig.1 in comparison with the not stressed zone:

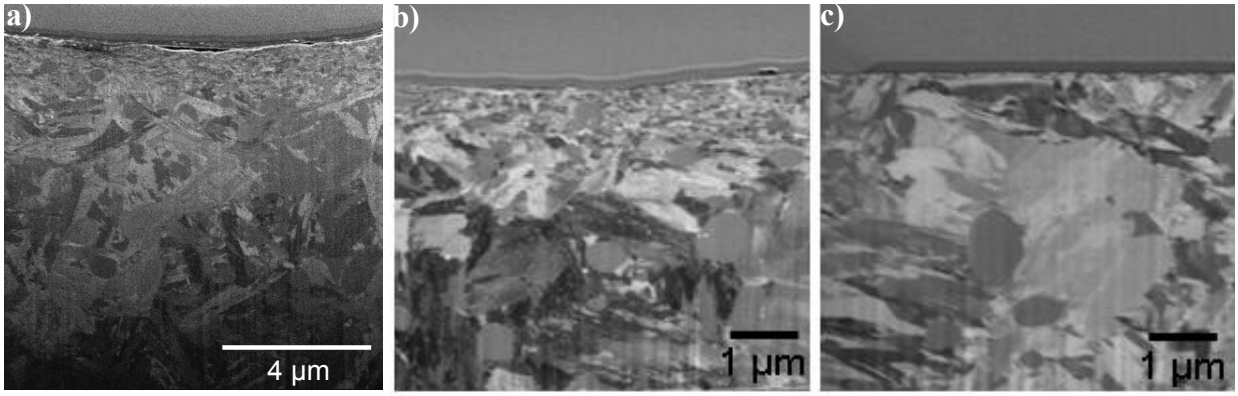

Figure 1: SEM Images of the subsurface worn regions at (a) 60°C, (b) 100°C and (c) and not stressed zone of sample.

Microstructural distortion and grain size gradients are clearly noticed. It is also clearly seen that the size of the affected zone was strongly dependent on the temperature. It is pointed out that the dual beam FIB/SEM equipment used for the analyses provides a fast and precise observation of near surface material alterations occurring in a very reduced scale [2].

References

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