

## SURFACE-INITIATED ROLLING CONTACT FATIGUE ON A DENT: MICROSTRUCTURAL EVOLUTION AND EFFECTS ON THE FAILURE MECHANISM

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### KEYWORDS

*Rolling contact fatigue; Fluid Lubrication; EHL; Microstructural characterization*

### ABSTRACT

To reduce CO<sub>2</sub> emission and comply with European legislation, automotive industry implements new electrical powertrains. It implies changes in the operating conditions of its bearings requiring new material development for bearing manufacturers. A typical mode of failure for bearings operating in contaminated lubricant is surface-initiated spalling on a dent (Fig. 1), such as in gearboxes or reducer boxes. To guide the development of new materials, a better understanding of the link between microstructure of the material and its performance in contaminated conditions is needed [1].

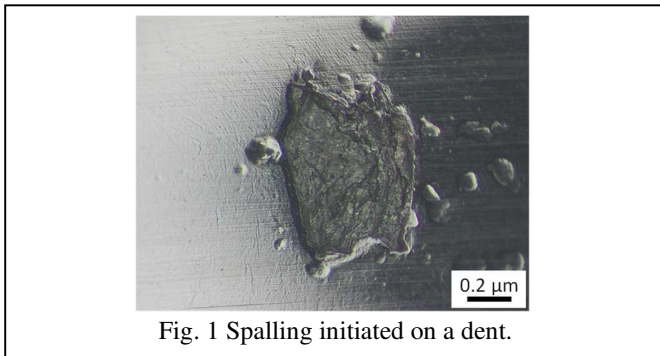


Fig. 1 Spalling initiated on a dent.

To address this issue, this study presents a multi-scale metallurgical characterization at different steps of the failure mechanism. To reproduce the failure mechanism occurring in gearboxes or reducers representatively, it was decided to study directly bearings operating in contaminated lubrication. Their inner ring is made of through hardened 100Cr6. The ball bearings are first indented using an open oil circuit containing a determined concentration of hard metallic powder [2]. After cleaning, they operate in clean lubrication until the failure of one of the two bearings due to spalling.

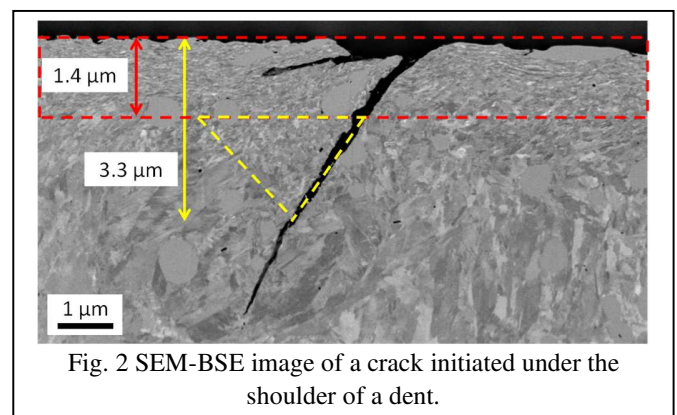


Fig. 2 SEM-BSE image of a crack initiated under the shoulder of a dent.

The microstructural characterization is performed using Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB) (Fig. 2), Transmission Kikuchi Diffraction (TKD), Transmission Electron Microscopy (TEM) equipped with ASTAR, around the dents before RCF, before crack initiation and after.

This study highlights the significance of shoulder plasticity in the initiation and propagation of cracks. Indeed, microstructural changes are confined under the dent of the shoulder. These alterations mainly consist in reorientation and fragmentation of the martensite into nanograins and spreading or shearing off the carbides. Based on these observations a plasticity mechanism is proposed for short crack initiation and propagation in case of surface RCF due to dent.

### REFERENCES

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