EBSD INVESTIGATION OF MICROSTRUCTURE REFINEMENT FROM IMPACT-BASED SURFACE TREATMENTS

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The mechanical surface treatments confer better local mechanical properties against wear or fatigue service conditions. In the case of impact-based treatments, a local microstructure’s refinement in the near surface is produced by a severe plastic deformation of the material, leading to a progressive reduction of the grain size over a few tens of microns, and consequently an increase of the hardness and tribological properties. These zones are commonly known as Tribologically Transformed Surfaces (TTS). In this project two different procedures are implemented to obtain TTS surfaces on pure iron samples: Shot-peening treatment and Micro-percussion tests. For the first technique the whole surface of the sample is impacted repetitively by metallic balls, otherwise for the second procedure every impact is effectuated on the same position by a rigid conical indenter, controlling the number, angle and velocity of impacts. The main purpose of this work is to establish a complete description of the transformed microstructures, to understand the mechanisms involved on the formation and evolution of TTS and discuss about the reciprocity of both techniques on the formation of these kinds of surfaces. EBSD crystal orientation mapping has been used to determine the size of the plastically deformed zone and the grain size distribution in the cross section of the impacted zone for both processes (Fig.1 and 2). A parameter sensitivity analyses on the number of impacts of the micro-percussion prints and the size of the deformed zone has been done. Estimation of the geometry necessary dislocations has been done on the deformed zone using HR-EBSD and cross-correlation technique. A correlation between the grain size, dislocation density and the mechanical properties gradient in the deformed zone has been done and will be presented.

Figure 1 – EBSD map of the cross-section of a TTS Surface produced by shot-peening impacts. Step size of 120 nm.

Figure 2 – EBSD map of the cross-section of a micro-percussion print (10000 impacts, 15°, 150 mm/s). Step size of 300 nm.