

# INVESTIGATION OF CONTACT-INDUCED NEAR-SURFACE MATERIALS TRANSFORMATIONS USING NANOMECHANICAL TESTING

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Mechanical surface treatments, such as shot peening – burnishing – deep rolling, are known for their efficiency to improve resistance to abrasive wear and local fatigue crack propagation. They are based on repeated contact loadings that create large plastic strains in the near-surface leading to compressive residual stress field and local grain refinement (Tribologically Transformed Surfaces, Fig1). A significant gradient of mechanical properties over 100  $\mu\text{m}$  is usually observed. This paper aims to present a methodology based on nanomechanical testing – i.e. micropillar compression, nanoindentation - and EBSD measurements to explain microstructure changes induced by such treatments. This methodology is applied to various cases ranging from severe shot peening (Fig1) to sliding friction contacts (Fig2).

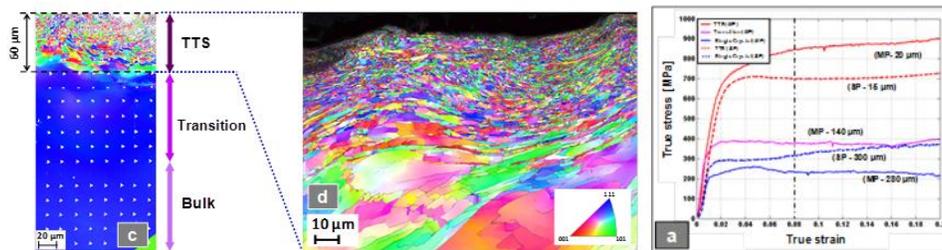


Figure 1 – Grain-refined zone after shot-peening (EBSD) and results of nano-compression testing along the depth.

Peening-based treatments lead to a continuous grain refinement over 50 to 100  $\mu\text{m}$  in depth, with the smallest grain size in the top layer. It is a consequence of severe plastic deformation, high strain rate and a negligible temperature rise. A positive relationship with the well-known Hall-Petch effect is observed which appears to be the main strengthening mechanism [1]. Sliding-based treatments combine effects of severe plastic deformation and high temperature rises, and thus enhances dynamic recrystallization phenomena. The resulting gradient of mechanical properties is shown to be significantly affected by recrystallization. Sliding wear tests were run to evidence the beneficial aspects of such treatments on wear resistance [2].

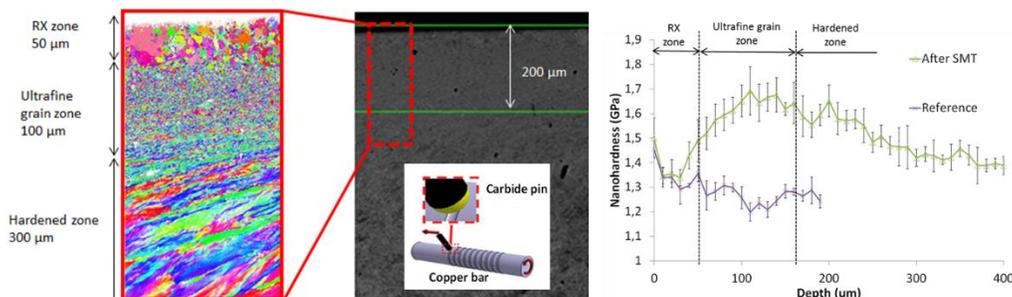


Figure 2 – Microstructural changes induced by high speed sliding-friction treatments (EBSD) and results of nano-indentation testing along the depth.

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