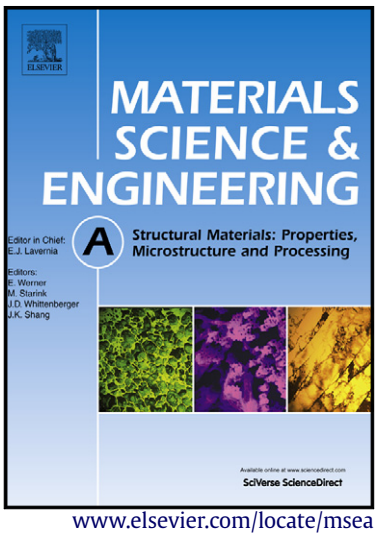

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Determination of the plastic properties of materials treated by ultrasonic surface rolling process through instrumented indentation

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Abstract

Ultrasonic surface rolling process (USRP) is a novel surface nanocrystallization technique based on severe plastic deformation (SPD). The combination of static extrusion and dynamic impact generates intensive plastic deformation, which leads to the strengthening of material surface. The present paper aims to investigate the mechanical properties of material surface after USRP. For this purpose, nano-indentation tests were adopted to obtain the load P and penetration depth h. Dimensional analysis of test results (P-h curves) was then performed for determining the microplasticity of treated material locally. The values of yield strength and strain hardening exponent of surface layer were calculated and verified by finite element simulation. Good agreement was obtained between experimental curves and simulated ones. The microstructural evolution of the surface treated by USRP was discussed to interpret the mechanism of surface strengthening. Finally, effects of USRP parameters including static force, vibration amplitude and repeated processing numbers on the variation of plastic parameters in surface layer were discussed.