THE INFLUENCE OF REINFORCING NANO-PARTICLES ON INDENTATION SIZE EFFECT AND MICROHARDNESS OF METALLIC MATERIALS

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The Nix-Gao model [1], that explains why the indentation microhardness increases with decreasing depth of the indent, is extended to describe the non-monotonous depth dependence of indentation hardness of metals containing very tiny rigid particles. In the original model, the microhardness is controlled by the density of dislocations needed to accommodate the imprint. In the extended model, additional dislocations are injected by rigid particles being pushed into material by an indenter. The resulting indentation hardness firstly decreases and then increases with increasing penetration depth. Such depth dependence of hardness qualitatively agrees with that observed for Fe-nanoZnO biomaterials.

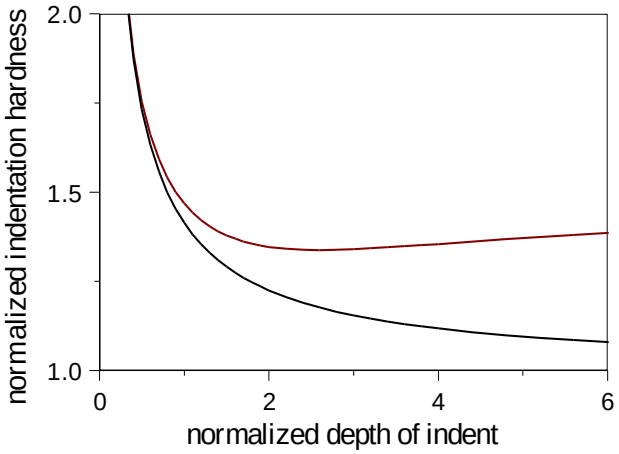

Figure 1 - Theoretical indentation hardness plotted as a function of the depth of indent. The curves presented were calculated for a pure metal (lower curve) and for a metal reinforced by a small amount of rigid tiny particles (upper curve). The curve for a pure metal equals to that of Nix and Gao [1].

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References
[1] W.D. Nix, H. Gao, J. Mech. Phys. Solids 46 (1998) 411-425.