OR1405

Effect of Xe+ ion bombardment induced patterns in stainless steel on plasma nitriding processes

Silvia Azevedo dos Santos Cucatti[1], E.A. Ochoa[2], M. Morales[1], R. Droppa Jr.[3], J. Garcia[4], H.C. Pinto[5], D. Wisnivesky[6], F. Alvarez[1]

[1]Instituto de Física, UNICAMP, Campinas, Brazil [2]Departamento de Física, PUCRJ, Rio de Janeiro, Brazil [3]Universidade Federal do ABC, UFABC, Santo André, SP, Brazil [4]Sandvik Machining Solutions, Stockholm, Sweden [5]Escola de Engenharia de São Carlos, EESC., USP, São Carlos, SP, Brazil [6] Plasma-LIITS, Equipamentos e Processos, Campinas, SP, Brazil

scucatti@ifi.unicamp.br

Pre-ion bombardment (~50-1000 eV) enhances the nitridation effect of plasma nitrided steel substrates. Several concomitant effects lead to improve nitrogen diffusion, such as surface cleaning and grain size refining of the near-surface of the material. The former eliminates undesirable nitrogen diffusion barriers formed by metallic oxides and the later creates nitrogen alternative diffusion path. Furthermore, the pre-treated steel surfaces by heavy ions (Xe^+, Kr^+, Ar^+) bombardment and posterior N^+ ion beam nitriding process improve adhesion and wear resistance in hard coatings depositing. In this paper we scrutinized the effect of Xe^+ ion bombardment at room temperature (10^3 eV, 0.37 mA/cm^2, 30 minutes) at different impinging angles ($\Theta=0^0$ to 75^0) on mirror polished 316 stainless steel. Afterward, the influence of the texture on plasma nitriding process performed at 380 ^{0}C is reported. The topography of the bombarded surface was characterized by SEM and AFM. A characteristic wavy periodic pattern following the material crystalline direction is obtained by the fact that different oriented grains present in the sample display different k number directions. This behavior is explained by the roughening instability model due to Ehrlich-Schwoebel diffusion barriers.[a] The experimental results show that the rms roughness increase from ~8 to 20nm from $\Theta=0^0$ to 75^0 ion beam impinging angle. The in-depth nano hardness profile, phase formation (DRX, XPS), and morphology after nitriding are reported and correlated with the topography generated by the ion bombardment for different Xe^+ impinging angles. Finally, the bombardment effects on the surface patterns are also reported and discussed as a function of the ion mass, energy, and dose. [a]W. L. Chana and E. Chason, J. of Applied Phys.101 (121301) 2007

Keywords
Surface modification
Ion-beam bombardment
Plasma Nitriding