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PII: S0169-4332(15)00254-8
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2015.01.212
Reference: APSUSC 29649

To appear in: *APSUSC*

Received date: 30-10-2014
Revised date: 27-1-2015
Accepted date: 27-1-2015

Please cite this article as: W. Chen, J. Zheng, Y. Lin, S. Kwon, S. Zhang, Comparison of AlCrN and AlCrTiSiN coatings deposited on the surface of plasma nitrocarburized high carbon steels, *Applied Surface Science* (2015), http://dx.doi.org/10.1016/j.apsusc.2015.01.212

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Comparison of AlCrN and AlCrTiSiN coatings deposited on the surface of plasma nitrocarburized high carbon steels

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Abstract: The AlCrN and AlCrTiSiN coatings were produced on the surface of plasma nitrocarburized T10 steels by multi-arc ion plating. The comparison of the microstructures and mechanical properties of the duplex coatings were investigated by means of X-ray diffraction, optical microscope, scanning electron microscope and transmission electron microscope, in association with mechanical property measurement. The results show that the AlCrN coatings with columnar grown are mainly composed of nanocrytalline fcc-(Cr,Al)N phases with {111} preferred orientation, whereas the superlattice and nanocomposite AlCrTiSiN coatings with planar growth mainly consist of nanocrystalline fcc-(Cr,Al)N phases with {100} perfected orientation, hcp-AlN and Si_3N_4 amorphous phases. The AlCrTiSiN duplex coating with the compound layer reveals higher hardness, adhesion strength, load capacity and lower friction coefficient when compared with the other duplex coatings, which is due to its superlattice and nanocomposite structure. Additionally, these improved properties are related to the appearance of the γ′-phase which plays the nucleation sites for the coating nitrides and provides a strong supporting effect for the AlCrN and AlCrTiSiN coatings. The main wear mechanism of the duplex coatings without compound layer is spalling and chipping wear as well as tribooxidation wear, whereas the main wear mechanism of the duplex coatings with compound layer is tribooxidation wear.

Key words: Multi-arc ion plating; AlCrTiSiN coating; AlCrN coating; Duplex coating; Plasma nitrocarburizing

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