PO2022

Study of microstructure, mechanical properties and thermal stability of Cr x Mo 1-x N coatings for machining tools

Issam RAHIL[1], Corinne NOUVEAU[1], Luc IMHOFF[2], Agnès FABRE[3], Laurent BARRALLIER[3], Valérie POTIN[2], Olivier HEINTZ[2], Benoît LAGANIERE[4]

[1]Arts et Métiers ParisTech, Cluny, France [2]University of Burgundy, Dijon, France [3]Arts et Métiers ParisTech, Aix En Provence, France [4]FPInnovations, Québec, Canada

rahil.issam@yahoo.fr

During a hard turning operation, the wear of the cutting tool produced by mechanical, thermal and physico-chemical stress leads to deterioration of the active portion of the tool. Today, most of the cutting tools are coated with a thin film (< 5µm) to protect them and enhance their service life. This research deals with the development of new protective chromium nitride-based coatings against abrasion and shock wear. CrxMo1-xN films have been developed on carbide cutting tools by dual R.F magnetron sputtering using Mo and Cr targets in an Ar+N2 atmosphere. The Cr and Mo content were varied by changing the target voltage from 0 to -900V and the influence of the composition on the tribological properties was studied.The composition of the layers was studied by EDS/WDS and XPS. These techniques revealed the presence of N, Cr and Mo in CrxMo1-xN films and less than < 5 at. % of oxygen. SEM observation showed a dense columnar microstructure of the CrxMo1-xN film similar to the CrN sample. X-ray diffraction analysis indicated that all deposited films were amorphous. All CrxMo1-xN films showed compressive residual stresses ranging from -6 to -10 GPa. Also, they showed hardness values between 7 and 10 GPa except MoN films which presented a higher hardness of 14 GPa. The friction coefficient of the CrxMo1-xN film was around 0,5-0,6. However, after ball-on-disk tests, SEM and WDS-EDS microanalysis confirmed that the layer composed of 24 at.% of Cr, 25 at.% of Mo and 51 at.% of N exhibited a better wear resistance compared to the CrN, MoN and other Cr-Mo-N films. Thermal stability of the deposited films has also been studied by heating the films in vacuum at temperatures ranging from 400 to 700°C. The physical, chemical and mechanical analysis revealed that the Cr-Mo-N films showed higher thermal stability than MoN and CrN thin films.

Keywords
Cr x Mo1-x N
microstructure,
hardness
friction- Wear