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Self-lubricating W-S-C-Cr tribological coatings deposited by r.f. magnetron sputtering

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Tribological coatings composed of transition metal dichalcogenides (TMD) have been studied for their excellent self-lubricant properties. However, they exhibit low load-bearing capacity, and their performance tends to deteriorate significantly in the presence of humidity. In previous works, doping disulfides and diselenides of tungsten and molybdenum has proven to be a way of greatly improving the tribological performance of this class of films in different environments.
In this work, thin films were deposited by r.f. magnetron sputtering on silicon and steel samples, using two targets (carbon and chromium) and tungsten disulfide pellets. The final composition was controlled by the number of WS2 pellets and the ratio of the power applied to the targets. The chromium content in the coatings was varied in the range 0 – 15 at.% and the S/W ratio was approximately 1.25 in all compositions in the series. The coatings were characterized in regard to their hardness, adhesion, chemical composition and bonding, microstructure and morphology, as well as their tribological behaviour.
Tribological tests were performed in humid air using a pin-on-disk tribometer. The applied contact load was varied and the wear tracks were examined, particularly by Raman spectroscopy and 3D profilometry. An adaptation in the equipment allowed the in-situ monitoring of the evolution of the wear tracks, by optical microscopy and Raman spectroscopy.
The results of characterization and tribology evidenced improvements in hardness and wear resistance associated with the dopants. Furthermore, the in-situ analyses yielded interesting results regarding the tribolayer formation during running-in and the sliding process.

Keywords
WS2
carbon
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coating