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## Ag-doped low friction coatings for wide temperature range applications

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One of the major challenges facing lubricant related research is the development of materials capable of maintaining both low coefficient of friction (CoF) and low wear rate in a wide temperature range. Nanocomposite coatings can combine advantages of hard and self lubricating phases and therefore are good candidates for various tribological applications at room and elevated temperatures. Doping with soft plastic components such as silver allows decreasing the CoF without significant decrease of materials hardness and wear resistance. In the present study, two groups of multicomponent nanocomposite coatings were originally studied: MoCN-Ag and TiNbCN-Ag. The coatings were deposited by magnetron and ion sputtering of metallic and composite targets. Structure and composition of the coatings and wear debris were investigated by means of XRD, HRTEM, SEM, Raman spectroscopy, and EDX analysis. The nanocomposite MoCN-Ag coatings revealed hardness in the range of 16 – 22 GPa. A significant reduction of CoF values above 350 °C was achieved by the formation of lubricious MoO3 and AgxMoyO phases during high-temperature tribological tests. Free carbon phase in the MoCN-Ag coatings provided low values of CoF (0.25) below 300 °C. Hardness of TiNbCN-Ag coatings was in the range of 10 – 41 GPa depending on Ag concentration (3 – 16 at.% Ag). The nanocomposite TiNbCN-Ag coatings demonstrated low wear rate 1.7–3.6 □ 10-6 mm3/N□m irrespective of silver content. The room temperature CoFs for the Ag-free and Ag-doped TiNbCN coatings were in the range 0.25 – 0.30. Above 450 °C, the TiNbCN-Ag coatings demonstrated lower values of CoF compared with TiNbCN coatings due to silver smearing in tribological contact zone. The maximum difference was observed at 700 °C: 0.80 (TiNbCN) and 0.45 (TiNbCN-Ag).The authors gratefully acknowledge the financial support from the Russian Scientific Foundation (Agreement No. 14-19-00273).

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