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Investigation of the Self-Healing Sliding Wear Characteristics of Niti-Based PVD Coatings on Tool Steel

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Abstract : Excellent damping capacity and superelasticity of the bulk NiTi shape memory alloy (SMA) makes it a suitable material of choice for tools in machining process as well as tribological systems. Although thin film of NiTi SMA has a same damping capacity as NiTi bulk alloys, it has a poor mechanical properties and undesirable tribological performance. This study aims at eliminating these application limitations for NiTi SMA thin films. In order to achieve this goal, NiTi thin films were magnetron sputtered as an interlayer between reactively sputtered hard TiCN coatings and hard work tool steel substrates. The microstructure, composition, crystallographic phases, mechanical and tribological properties of the deposited thin films were analyzed by using field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), nanoindentation, ball–on-disc, scratch test, and three dimensional (3D) optical microscopy. It was found that under a specific coating architecture, the superelasticity of NiTi inter-layer can be combined with high hardness and wear resistance of TiCN protective layers. The obtained results revealed that the thickness of NiTi interlayers is an important factor controlling mechanical and tribological performance of bi-layer composite coating systems.

Keywords : PVD coatings, sliding wear, hardness, tool steel
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