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DLC tribological coatings with embedded piezoelectric thin-film sensor

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Abstract:

In the present work, the feasibility from the mechanical behavior point of view of embedding piezoelectric interlayer sensors between wear resistant a:C-H coatings and steel substrates was evaluated. The wear sensor composed by a bottom electrode of Ti and a piezoelectric AlN layer, along with the adhesion Cr interlayer (and top electrode) were deposited by sputtering, while plasma assisted chemical vapor deposition was used to build up the tribologically effective diamond-like carbon coating. The effects of the AlN/Ti interlayer on the properties of this system of coatings were investigated by several means. The results showed that the presence of AlN/Ti interlayers is reducing the carbon sp3 content in the a:C-H top coating and is increasing the bonded oxygen at the surface of this, which, in turn, leads to an increased chemical activity, giving rise to abrasive wear and a higher friction coefficient. The adhesion to the steel substrate of these multilayer coatings, compared to an a:C-H/Cr coating, used as reference, was improved by up to 68%. However the hardness was gradually degraded by up to 16%, compared to the same a:C-H/Cr film. This indicates that the AlN/Ti interlayers might decrease the mechanical strength of the top DLC films, but bring benefits in terms of adhesion to the steel substrate.