Influence of Counterface and Environmental Conditions on the Lubricity of Multilayer Graphene Coatings Produced on Nickel by Chemical Vapour Deposition

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Abstract : Friction and wear properties of multilayer graphene coatings (MLG) on nickel substrate were investigated at the macroscale, and different failure mechanisms working at the interface of nickel-graphene coatings were evaluated. Multilayer graphene coatings were produced on a nickel substrate using the atmospheric chemical vapour deposition (CVD) technique. Wear tests were performed on the pin-on-disk tribometer apparatus under dry air conditions, and using the saltwater solution, distilled water, and mineral oil lubricants and counterparts used in these wear tests were fabricated of stainless steel, chromium, and silicon nitride. The wear test parameters such as rotational speed, wear track diameter, temperature, relative humidity, and load were 60 rpm, 6 mm, 22˚C, 45%, and 2N, respectively. To analyse the friction and wear behaviour, coefficient of friction (COF) vs time curves were plotted, and the sliding surfaces of the samples and counterparts were examined using the optical microscope. Results indicated that graphene-coated nickel in mineral oil lubrication and dry conditions gave the minimum average value of COP (0.05) and wear track width (~151 μm) against the three different types of counterparts. In contrast, uncoated nickel samples indicated a maximum wear track width (~411 μm) and COF (0.5). Thorough investigation and analysis concluded that graphene-coated samples have two times lower COF and three times lower wear than the bare nickel samples. Furthermore, mechanical failures were significantly lower in the case of graphene-coated nickel. The overall findings suggested that multilayer graphene coatings have drastically decreased wear and friction on nickel substrate at the macroscale under various lubricating conditions and against different counterparts.

Keywords : friction, lubricity, multilayer graphene, sliding, wear
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