The NanoTriboTest - novel multi-sensing nano/microtribology combining electrical contact resistance and friction measurement

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Nano-/micro-scale tribology enables the onset of wear to be studied in detail and correlations with friction forces investigated to aid the design of surfaces with improved wear resistance. Reciprocating contacts occur in a wide variety of practical wear situations including hip joints and electrical contacts. In optimising materials for improved durability in these contacts it is important that the contact conditions can be reproduced.

A capability for rapid high-cycle linear reciprocating nano-scale wear tests has therefore been developed (NanoTriboTest) with automatic recording of friction loops, cumulative energy dissipation and electrical contact resistance [1-2]. The design has high level of lateral rigidity providing the necessary stability to perform nano-wear tests for several hours, up to 35000 cycles and 300 m sliding distance. High cycle reciprocating nano-wear tests have been performed on multilayer DLC coatings, and biomedical alloys Ti6Al4V and 316L stainless steel. Stainless steel exhibited a ductile response throughout the load range but an abrupt transition to higher friction and fracture-dominated wear occurred on Ti6Al4V. Improved detection of the onset of wear and the subsequent failure mechanisms was achieved by a multi-sensing approach where changes to electrical contact resistance were shown to correlate with friction. Nano-wear tests of noble metal-noble metal contacts showed much longer endurance than gold vs. steel contacts although occasional isolated failures were observed in 35000 cycle tests.

[1] Influence of Si- and W- doping on micro-scale reciprocating wear and impact performance of DLC coatings on hardened steel, BD Beake, SJ McMaster, TW Liskiewicz, A Neville, Tribol Int 160 (2021) 107063.

[2] Friction and electrical contact resistance in reciprocating nano-scale wear testing of metallic materials, BD Beake, AJ Harris, TW Liskiewicz, J Wagner, SJ McMaster, SR Goodes, A Neville, L Zhang, Wear, 474-475 (2021) 203886.

Keywords: nanotribology, topography, scratch, microtribology.

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