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Biotribology paper

Influence of indenter geometry on the frictional sliding resistance of tooth enamel.

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Abstract: Indentation force-displacement and sliding scratch resistance measurements have been conducted on orangutan tooth enamel. Tests were made with a corner-cube (CC), Berkovich, as well as spherical (nominally 1 μm and 5 μm radius) indenters. Indentation loads ranged from 100-5000 μN and were also made on fused silica to calibrate the indenter tips. The frictional force as a function of sliding distance was measured with the atomic force microscope (AFM) option on the indenter system as well as using a high precision AFM and scanning electron microscope (SEM). The frictional resistance was found to be almost constant with indenter load for the CC and Berkovich indenters; for the CC, it depended upon the orientation of the sliding indenter. For the spherical indenters, the 1μm showed a sharp increase in frictional resistance with increasing load whereas for the 5μm tip there was minimal change. Observations of the resultant scratches showed ploughing/cutting with the sharp indenters and a transition from an "ironing" like deformation for all the 5μm tests and for the low load 1 μm tip with ploughing at the heaviest load. In the case of the sharp tips a "metallic" like discontinuous swarf removal process was evident. It was found that the frictional resistance force scaled with the effective rake angle of the indenter tips. Implications of the current observations for understanding tooth wear are considered.

Key-words: Enamel, abrasion, indentation scratch tests, frictional resistance,