Influence of ambient gas conditions on wear of 1500 m/s high speed electric sliding contacts

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This study deals with the influence of the ambient gas conditions on wear phenomena occurring under extreme conditions. The tribometer used allows investigating sliding electric metal-metal contacts at very high speeds. For this study, sliding speeds up to 1500 m/s have been realized, resulting in a current profile characterized by a peak amplitude of 580 kA. The tribo partners consist of highly conductive materials. A non-reusable Al6061-T6 slider is accelerated between a pair of 3.18 m long CuCr rails by electromagnetic forces from zero speed to 1500 m/s. Sliding experiments are performed at ambient air and under nitrogen flow at normal pressure. We observed characteristic features, qualitatively and quantitatively. Note that no time-dependent wear regimes are investigated.

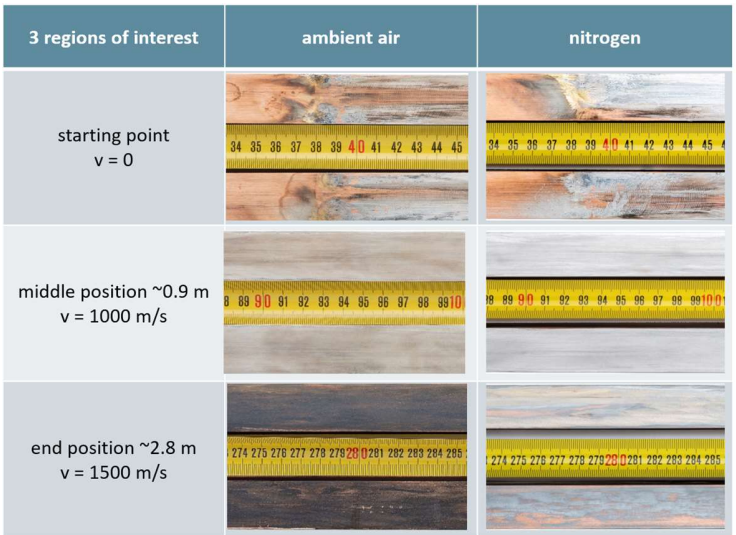

Fig.1: Wear phenomena under ambient air and N_2 atmosphere

Three regions of interest were analyzed in detail clearly showing significant atmospheric influence (fig.1). For all three regions oxygen incorporation at the surface was proved by SEM-EDX measurements for sliding under ambient air whereas oxygen incorporation is strongly suppressed by nitrogen atmosphere. Further microscopic analysis (optical and SEM) reveals that the starting point is dominated by electrical phenomena and Joule heating leading to melting and intermixing of both Cu and Al. At the middle position (v = 1000 m/s), only the slider is melting and melt lubrication is observed. At a sliding speed of 1500 m/s rail degradation is strongly enhanced by ambient air and oxidation is likely. The analysis of the chemical reactions and the formation of oxides is currently ongoing. Deposition layer thicknesses vary from about 100 µm at the starting point to 5 µm at 1500 m/s.

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