INFLUENCE OF HYDROGEN-CONTAINING ATMOSPHERES ON FRICTION AND WEAR OF DIAMOND-LIKE CARBON UNDER RECIPROCATING SLIDING

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ABSTRACT
Endogenous gaseous hydrogen shows beneficial influence on the tribological behavior of systems when hydrogenated amorphous carbon (a-C:H) is used as a solid lubricant [1]. It is shown with an ultra-high vacuum tribometer that a partial pressure of hydrogen of more than 50 mbar is sufficient for some a-C:H films to result in a reduction of the friction coefficient [2]. It is widely accepted that the reason for these good properties is the formation of a transfer layer on the uncoated body, the termination of the dangling bonds of C-atoms with hydrogen and the physical adsorption of hydrogen on the coating surface [3,4].

To carry out experiments in pure hydrogen, complex safety technology is required, as there is a risk of oxyhydrogen gas formation. This risk, and therefore the need for complex safety technology, does not exist if gas mixtures of hydrogen and nitrogen up to a 5 % concentration of hydrogen are used.

Experiments with two different a-C:H coatings were carried out in a linear reciprocating tribometer according to DIN 51834-1 updated with a gas containment. The coatings differ in their endogenous hydrogen content and sp2/sp3 ratio, with comparable hardness and elastic modulus (DLC 1 and DLC2). A continuous flow of nitrogen, a 2% hydrogen in nitrogen mixture or a 5% hydrogen in nitrogen mixture is fed into this gas containment. The oscillation stroke was set to either 200 or 2000 µm, while the frequencies of 4, 10 and 40 Hz were analyzed.

The results can be categorized, as shown in Figure 1.

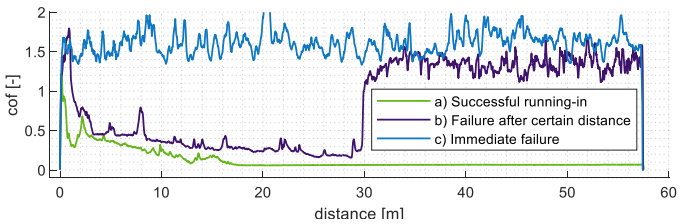

Figure 1: Overview of friction coefficient (cof) curves

Table 1 shows the summary of the results in connection with Figure 1.

Table 1 Parameter-dependent cof-curves regarding Figure 1

coating	gas	0% H2		2% H2		5% H2	
	stroke [µm]	2000	200	2000	200	2000	200
DLC 1		c)	c)	b)	a)	a)	a)
DLC 2		c)	c)	b)	a)	b)	a)

The behaviors can be explained with the adhesion of the tribofilm and wear coefficients which are dependent on endogenous and exogenous hydrogen contents. Subsequent tests under 100% hydrogen atmosphere are planned and will be explored in a future study.

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