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Wear Rates of CoCr Alloys Crucially Depend on Counter Body in Ball-on-Disc TestsJohanna Lutz¹, Stephan Mändl²¹TRM Leipzig, Leipzig, Germany ²Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Germany

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CoCr alloys are widely used as biomaterials, e.g. for coronary stents or total hip replacements, despite still unsolved problems arising sometimes from an increased release of Co ions or the generation of excessive wear particles. By thermochemical surface treatments, it is possible to obtain hard and wear resistant surface layers. A strong reduction of the abrasive wear volume was found in previous experiments when testing against ceramic balls in ball-on-disc geometry for experiments in air and simulated body fluid, together with a significant reduction of the friction coefficient, while only a slight dependence on the CoCr alloy composition is present.

Now, similar results are obtained with hardmetal balls. However, when additionally employing CoCr balls - treated and untreated - as counter bodies, a more differentiated picture is emerging. For wear couples consisting entirely of nitrided CoCr alloys, a reduced wear rate is still observed with predominantly abrasive wear and no fretting or cold welding. When using nitrided CoCr against native CoCr in dry conditions, a strong abrasive wear for the untreated side is observed, despite a lower friction coefficient compared to a purely untreated-untreated combination. Thus, a wear process depending more on the relative mechanical yield strength of the partners and less on the energy deposition by friction processes in the total system can be postulated. At the same time, massive fretting corrosion of the nitrided part is observed in simulated body fluid, indicating contact corrosion with a reduced corrosion potential on the nitrided side. When using metal-on-metal components for articulating surfaces, extreme care has to be taken to assure that surface modifications are applied for both components.

KeywordsCoCr
wear
PIII