Mechanisms of oxide dependant tribological behaviour in Ti / Steel sliding

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Abstract

Friction has been investigated for a very long time and a few models have emerged. The first model most well-known and most used is the Coulomb's law. According to this model the coefficient of friction is the ratio of the tangential load, needed to produce a relative movement between the two surfaces in contact, divided by the normal load. A second model by Godet introduced the third body as a way to understand what happens during the friction and the wear of the surfaces and also to understand how the coefficient of friction evolves.

The analysis of the tribological behavior of a steel ball on pure titanium has been carried out under alternative motion on coarse grained Ti surface and on Ti surface deformed by surface mechanical attrition treatment (SMAT). An abnormal wear of the steel ball, despite being several times harder than the Ti surface, has been observed. The coefficient of friction on both surfaces revealed important variations along the duration of the tribology test. These variations were interpreted as a three stages sequence of different wear mechanism. The initial stage corresponds to wear of the titanium surface, whereas stage II shows a mixed wear between the titanium surface and the steel ball before the wear of the steel ball during stage III. The analysis shows that these transitions are due to the successive formation of different oxides during the tribology test. The SMAT appeared to change the oxide formation kinetics and lengthened the different stages. This is attributed to a lesser plastic deformation of the surface, the heat generation is slower and the oxide generation is slowed.