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Chemical effects on metal friction at the nanometer scale

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Understanding and controlling the surface mechanical behavior of materials is crucial for the development of new devices. We have investigated the sliding friction behaviors of different metallic couples with different enthalpy of mixing or reaction by friction force microscopy. In the low load regime, the friction between a single asperity, such as an AFM tip, and a metallic surface is governed by the formation of a junction and it's shearing. Comparing the friction behavior of miscible and immiscible couples, we find that in the first case friction is governed by adhesion while the friction force is almost independent on the normal load. In the latter case of immiscible couples, adhesion is found to be low and the friction force linearly increases with the normal load. Statistical analysis of atomic stick-slip images recorded on an Au(111) surface with tips of different affinities with gold allows for a deeper understanding of our results. Expectedly, the periodicity of atomic stick-slip images corresponds to the interatomic distance of gold for immiscible counter-bodies. In contrast, for a reactive couple the periodicity of atomic stick-slip significantly differs from the gold interatomic distance and may correspond to structural length of an ordered phase at the tip-surface interface. These results provide new insights in the formation of interfacial alloys and their effects on metals friction. Furthermore, our findings shall serve as new guidelines for the selection of material couples for micromechanical devices involving sliding contacts.

Biography

Arnaud Caron is a Material Scientist with expertise in "The multi-scale mechanical behavior of materials, surfaces and micro-components". He has been an Assistant Professor at School of Energy, Materials and Chemical Engineering, KoreaTech, Republic of Korea since 2015. He completed his Engineering Degree in Materials Science in 2004 at University of Saarland, Germany. In 2009, he completed his Doctoral Degree in Materials Science at University of Saarland, Germany. From 2006 to 2015, he worked as a Research Associate at Institute of Micro- and Nano Materials, University of Ulm, Germany; WPI-Advanced Institute of Materials Research, Japan and; Leibniz-Institute for New Materials, Germany.

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