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**Fundamental deformation processes controlling nanoscale friction and wear**

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Thermally activated processes are often responsible for the kinetics of deformation and can control tribological performance. In this contribution two such processes are discussed in combination with nanoscale tribology experiments using atomic force microscopy (AFM). The first process describes single asperity wear as an atom-by-atom loss process driven by frictional shear stresses an interface. The wear rate is described by a thermally activated bond breaking process in which the energy barrier is reduced by the frictional shear stress. This leads to dramatic deviations from Archard's wear law which is commonly used to described macroscopic wear. Experimental confirmation of an atom-by-atom wear process is given by AFM wear experiments using different material combinations of tips sliding on surfaces [1]. The second process relates fundamental rearranging processes in polymers to friction. As an example, data of sliding friction between a silicon tip and a highly cross-linked polyaryletherketone film using friction force microscopy are presented. Energy dissipation into so-called molecular relaxations (alpha and beta relaxations) is identified as distinctive maxima of the friction force as a function of temperature between 150 and 500 K. A strong shift of such peak temperatures as a function of applied load is observed. Again, a model with an Arrhenius activation modulated by the applied shear stress describes experimental results quantitatively. The effect of the stress-shifted relaxation on friction-versus-load experiments is discussed [2]. Both processes will be discussed in the context of technological applications.

[1] B. Gotsmann and M. A. Lantz, Phys. Rev. Lett. 101, 125501 (2008)
[2] L. Jansen et al. Phys. Rev. Lett. 102, 236101 (2009)