

Materials Day 2007: Sticking and Sliding, Wearing and Tearing

Tribology and Adhesion Issues in Materials Science

«Biomimetics in Lubrication Science and Engineering»

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Biomimetic approaches draw increasing attentions in modern science and technology. In an effort to establish this approach in lubrication science and technology, the researches on this topic carried out in our group in the last a few years will be presented. Among many features that are observed from biological lubrication approaches, we took a particular note on the fact that they are mainly lubricated by water. This may appear paradoxical since water is generally not an efficient lubricant for most man-made tribosystems due to its extremely poor capabilities to take up external loads on its own. This barrier is, however, less important, when elastomers are employed as tribopairs, since a low-pressure, conformal contact is readily achieved under these conditions, and thus the soft elastohydrodynamic lubrication (soft EHL) mechanism can be activated, for which the increase of viscosity under pressure is not necessitated. An outstanding example is the remarkable water-based lubricating performance of natural, articular joints. The application of this approach to engineering tribosystems, such as aqueous lubrication of elastomers and/or elastomeric coatings on the rigid surfaces, however, requires a careful control of surface properties of tribopairs since hydrophobic interactions between the sliding surfaces in water can result in the failure of lubricating films to form at low sliding speeds. A range of challenges to modify and characterize the influence of surface chemical modifications, including high-energy source, surface-grafting of synthetic and biomacromolecules, and self-assembly of organo thin films, will be discussed in detail.