FRICTIONAL DISSIPATION IN SELF ASSEMBLED ORGANIC MONOLAYERS

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Organic molecules in their monomolecular assemblies are known to provide chemical and mechanical protection to metallic substrates subject to tribological interactions. These molecules of nanometric lengths and hydrophobic terminal ends can be chemiadsorbed to provide good load bearing capacity and low friction dissipation.

These objectives may be achieved by a chemical or a physical route. In the chemical route the frictional dissipation is lowered by the formation of a reaction product of low shear strength. The precursor to such a reaction is the electronic charge coupling of the molecular backbone and the substrate, the contact pressure acts as an activator to bring the two bodies within a proximity to enable such a coupling. The load bearing capacity of these films may not be too high. Making the molecules stiffer or more load bearing cuts off the chemical route and dissipation is achieved by opening up new avenues of molecular deformation whereby the molecules tilt or rotate to do work under tractions. The relaxation behaviour of the molecules influenced by contact pressure and sliding speed determine the accumulation of defect population with sliding. While this mechanism implies that friction and adhesion increases if the molecules are less rigid, it is found experimentally that more rigid and bigger molecules have greater frictional resistance. The issue is addressed considering the barrier energies to be overcome for molecular motion under shear and it is found that the property of an assembly to shear coordinate or to organize a contact coherently, as well as the activation energy related to the molecular repulsion, opposedly control the barrier height and therefore the friction. We end the talk by noting the dramatic effect of environmental humidity on friction of these hydrophobic molecules. We believe that work such as this is of importance to the design of metal cutting and metal working processes as well as to the performance of internal combustion engines.