

RUBBER ADHESION AND FRICTION: ROLE OF SURFACE ENERGY AND CONTAMINATION FILMS

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The friction and adhesion between rubber materials and a counter surface have many practical applications, e.g., for tires, conveyor belts, rubber seals, and pressure-sensitive adhesives. We study the influence of the surface energy and contamination films on rubber adhesion and sliding friction in dry and wet environments. We find that there is a transfer of molecules from the rubber to the counter surface, which reduces the work of adhesion and makes the rubber friction insensitive to the substrate surface energy. We show that there is no simple relation between adhesion and friction. Thus while the pull-off force in fluids may be strongly reduced (due to a reduction of the work of adhesion), the sliding friction may be only slightly affected as the area of real contact may be dry, and the frictional shear stress in the contact area nearly unaffected by the fluid.

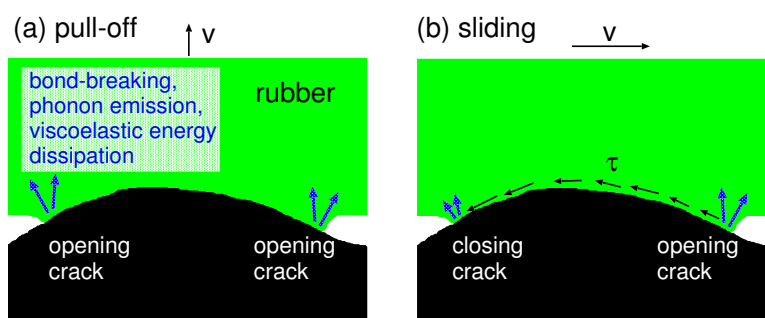


Figure: There is in general no simple relation between adhesion (pull-off force) and sliding friction. (a) The pull-off force depends on breaking the bonds in the normal direction at the edges of the contact region (opening crack propagation). (b) The friction force depends on energy dissipation at the opening and closing crack tips, and in addition on shearing the area of real contact, i.e., on processes occurring everywhere within the contact region. In many cases this latter contribution will give the most important contribution to the friction force[1-3].

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