Friction coefficient dependence on electrostatic surface charging

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***Abstract*— Friction between dielectric surfaces produces patterns of fixed, stable electric charges that in turn contribute electrostatic components to surface interactions between the contacting solids. Surprisingly, the effect of triboelectricity on friction coefficients is as yet poorly defined and understood and this is largely due the complexity and poor understanding of tribocharging mechanisms and effects. The models and mechanisms described in the literature for friction and wear seldom mention the tribocharging effects that are necessarily observed whenever two solids are in mutual contact and these are not considered even in recent and detailed experimental-theoretical analyses. Four types of experimental results are described in this work, on rolling and sliding friction. Rolling friction of glass spheres increases with electrostatic potential on PTFE films that were charged by repeatedly rubbing flat glass over PTFE that reached electrostatic potential as high as 1000V. Neutral glass spheres roll over charged PTFE but they quickly stop, after moving for only a fraction of the distance observed in uncharged PTFE, showing that charging introduces a powerful mechanism for mechanical energy dissipation. The widely used standard for friction assessment, the coefficient of rolling resistance (CoRR) of glass spheres on charged films was measured as a function of the average potential on the film and it increases many-fold in charged PTFE, in a potential range that is easily achieved by rubbing this polymer with glass and other common materials. However, glass surface modification with silanes eliminates the effect of tribocharged PTFE on glass rolling friction and this is explained considering a mechanism based on charge induction by the electrified surface. Static friction coefficients of PE pellets on PTFE were also shown to depend on static charging and lateral force microscopy (LFM) imaging on tribocharged PTFE showed that nanoscale friction coefficients also increase manifold. These results suggest new approaches to control friction coefficients, by controlling tribocharge formation.**