

# **Multiscale Simulation of Friction and Wear**

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Tribology is a technology and science about the physics and chemistry between two sliding surfaces, such as friction, wear and lubrication. Although control of friction of machine elements is essential for both economy and ecology, understanding of friction is still an open question. In this talk I will introduce our multi-scale material simulation for both solid and soft materials, such as coatings and oil. To reproduce the multi-scale nature of the oil, i.e. solution of base oil with super molecules, such as grease, polymer and polar additives, we made a simulator which couples Brownian dynamics of molecules with fluid dynamics (BDLBM). For the analysis of solid friction, we made a coarse-grain simulator based on smoothed particle hydrodynamics (SPH). The solid materials are modeled as ensemble of coin like particles, and both elastic friction and friction including elastic plastic deformation are treated. For the material modeling of multi-scale simulator, all atom molecular dynamics simulation is also used. The mechanism of viscosity control of polymer additives are solved using BDLBM simulator. The origin of flash temperature is found using the SPH simulator. We then apply these techniques to estimate the friction and wear of environmental friendly applications such as wind turbine bearing, bearing of electric vehicles.