"Friction": a Supramolecular Affinity

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Abstract

"*Friction*" is not a fundamental force interpreted from action-reaction hypothesis in structuring heterogeneous academic content. Energy loss is viable in human life, biomimicry membrane amphiphilic soft-matter, planetary large fields, and materials-energy balance of engineering applications at mechanical contacts. Biomimicry of nature materials favor heterogeneity at hydrophilic-hydrophobic interphase with third bodies environment for equitable friction, energy dissipation, and supramolecular interactions.

1 Introduction

The effect of friction and wear at sliding mechanical contacts have been presented on socioeconomic, energy consumption, carbon footprints, and global scales [1]. The energy loss at mechanical contacts of transport sector, CO_2 emission for assessment of environmental load, sustainability, and quality of life have a relationship for a synergistic impact of society [2]. The mechanical engineering and tribology for designing bio-lubricants, functional surfaces, and fluids have been paving scientific platform towards achievement of sustainability and socioeconomic values of quality of life [3]. Tribology for sustainability and reliability are necessary for well-being of human life, the economic growth, efficiency of mechanical operations, and energy optimization at interface of human machinery indirect or direct contacts [4-5]. Natural fiber polymeric composites with thermoplastic and thermoset matrices have been preferred by car manufacturers and suppliers for dashboards, package trays, door panels, seat backs, headliners, and interior parts offer socioeconomic and green technology benefits such as reductions in weight, cost, and CO_2, less reliance on foreign oil sources, recyclability, durability, abrasion resistance, and thermal resistance [6]. The decarbonization strategies for tribological contacts in transport sectors are viable for harmony of socioeconomic, academic, scientific, technology, policy, and sustainability. A few layers of molecular or synthetic polymer coatings are seen over household fitting/fixtures/walls/furniture/utensils for providing durability, green technology, abrasion resistance, thermal resistance, moisture resistance, non-stick performance, economy, human development indicators, and affinity.

2 Interfaces

The rough water repellent plants such as *Brassica oleracea L., Colocasia esculenta (L.) Schott., Mutisia decurrens Cav., Nelumbo nucifera* have shown the interdependence between surface roughness, water repellency, and supramolecular adhesion in explaining the self-cleaning mechanism of bio-interfaces against environmental third bodies contaminants [7]. The nature is for millennia creating plants, insects, and biological surfaces, interfaces, and interphases able to repel water and low surface tension oils for superhydrophobic/superoleophobic interfaces for defeating environment reactions [8]. The van der Walls adhesion mechanism of Gecko setae for transient attachment and detachment is an electrostatic force or electroadhesion for modulation of surface tension in perfect sticking over hydrophobic, hydrophilic, and hybrid surfaces [9]. The drag power experienced by dolphin is a cumulative integrity of thrust power or kinematic energy dissipation of shape and muscle power for achieving mechanical efficiency [10]. The fish skin slippery mucus is to protect fish against predator attack, allowing fish to swim faster due to low friction coefficient, and bionic hydrogels at man-machine interface in micromechanics, actuators, and sensors designing [11]. Bio-inspired science is an interdisciplinary field of researchers in designing and manufacturing of bionic surface useful for engineering applications [12]. The design and development of superomniphobic functional surfaces is an academic area or industrial interest due to the applications that encouraged number of scientists and engineers contributing to a range of novel superomniphobic surfaces [13]. The homogeneous molecular environment creates cohesive force, heterogeneity for adhesive force, and free surface energy or surface tension for binding surface molecules in a free environment using a generalized equation.

$$\gamma_{SV} = \gamma_{SL} + \gamma_{LV} cos\theta \qquad \text{(i)}$$

Where, γ denotes to surface energy, subscripts S, L, and V refer to the solid, liquid and vapor phases, and θ is static contact angle in a thermodynamic equilibrium of smooth and homogeneous surface. The free surface energy of a virtual surface in ultra-vacuum is "*Zero*" in absence of environmental reactions. The fluorinated carbon is not synthesized by nature consciousness and a functional category for designing low surface energy or non-stick coatings in applications [14]. The definition of hydrophilicity, hydrophobicity, and superhydrophobicity have a relationship with static contact angle of water [15]. The prospective author structured a few academic expressions for realization of friction characteristics of rubbing interfaces in a boundary lubrication, mixed lubrication, and HD lubrication regimes [16-19]. The tribological performance in engineering applications shall be upgraded for designing of functional interfaces in reducing energy loss, sustainability, reliability, and mechanical resistance.

3 Case Study

Author carried a case study of action-reaction hypothesis of dynamic ceramic stone at tribological contact with flowing water. The ceramic stone at TRIBO interface of flowing water created reactive force over water surface of canal and water reservoirs by providing maximum human impulsive action at stone along the direction of water flow with small angle. The observation of high friction at initial phase for re-bounding of stone manifold at tribo-interface had predicted from surface tension evolution and high resistance than static condition before sinking due to gravity. The friction of soft matter at surfaces, interfaces, and interphases is a function of state variables viz. velocity, acceleration, inertia, heterogeneity, surface energy, and residual environmental conditions.

Conclusions

The author conclusion has been enumerated for fundamental study of adhesion, lubrication, and friction in daily life. The design and development of surfaces, interfaces, and interphases functionalities have been encouraging academic fraternity for reducing energy loss at tribological contacts as per the requirement of socioeconomic parameters.

1. "Tribology" is a science of energy dissipation of rubbing surfaces from bio-friction, mechanical contacts of machineries, and large fields up to seismology
2. The sticking and slipping boundaries including real area of contact evolve perceptible friction due to high energy dissipation such as "Stick-Slip" friction
3. The permeability, biocompatibility, and mechanical properties of amphiphilic membrane or hydrogels subjected to biomechanical loading provide low friction coefficient at bio-tribology interface
4. The low surface energy fluorinated carbons are emerging functional materials for non-stick cookware coatings than conventional matter or anodized tribological surface
5. The violation of classical law of friction at bio-tribology interface is predicted from the interfacial thermodynamic diffusion, viscoelasticity, and diversity of biology

"*Friction*" is an irreversible combined effect of adhesion, capillary action, elasticity, chemistry, surface topography, and heterogeneous environment at macro, micro, and nanoscales.

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Author contribution

Author structured a perspective or a personal viewpoint by amalgamation of heterogeneous contents as per the requirement in "*Originality*" of academic expression

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