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Bio-Inspired Engineering at the Spectrum of "Tribology"

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Abstract

Self-cleaning mechanism of lotus leaves or "Lotus Effect" is a hydrophobic effect against adsorption of environmental water molecules on exposed surface. The low surface energy and surface tension of bio-inspired surface are useful in designing and manufacturing of functional coatings. The science, technology, and industrial revolution eased non-stick functional Teflon coatings up to cookware due to much lower free surface energy and surface tension (~18.0 mN/m) than dynamic water molecules, steels, aluminium, and anodised materials.

Keywords: Bionic, Environmental reactions, Thermodynamics, Surface engineering, Tribology

1. Introduction

The disruption of coronavirus is a sociotechnical upgradation of virtual activities at stick-slip friction domain of android phones, smart electronic gadgets, and touch pads. The stick slip surfaces for the assessment of tactile perception are randomly rough for the topographic structure such as shape, size, and roughness are the factors for tactile perception [1-4]. The smartphones are ubiquitous in diverse areas of our daily lives seeking personal security or privacy policy on these devices which uses information about the biometric or inherent characteristics of every person from tactile texturing of rough natural surface [5]. Multispectral imaging of the skin tissue and mechanoreceptors provide information of surface/subsurface characteristics as textures in identification of individuals [6-8]. The soft tribology of finger on electromechanical surface is highly visible for the last few years in educational institutions, market places, and at home appliances. The surface characteristics of engineered substates, environmental protection against third bodies adsorption, and reducing net mechanical efficiency of individuals have been invincible for an effective energy balance. The automotive multimedia touchpad is one of the fast-growing industries including the market size, growth prospects, and outlook as music binds and regulate human emotions during driving or traveling [9]. Soft polymers and Polyethylene Terephthalate (PET) produced by a chemical reaction of

ethylene glycol monomer with terephthalic acid has excellent dimensional stability, high light transmittance, and crack-resistant plastic for economical perception in automobile and consumer electronics [10-11]. The textured human finger, oleophobic engineered surface, and environmental conditions regulate electroadhesion for effective information mechanism between human neural with electronic devices.

2. Hydrophobicity

Everyday non-stick cooking has been added quality, durability, versality, energy saving, safety, and sustainability due to low surface energy of mechanical substrate. The ultra-low surface energy and surface tension of rough Teflon® coating over aluminium cookware ease non-stick performance for oleophobic food substrate, low specific volume of product, and a broad quality from socioeconomic frontier [12-13]. The reliability, durability, and mechanical handling of Teflon® coating over aluminium are rational than hard anodized, stainless steel, mild steel, and aluminium made cookware for a domain of six months in multiple man-cookware handlings [14-15]. Young equation (1805) is a conventional relationship of surface tension at the three-phase contact line by a balance of the solid–vapor, solid–liquid and liquid–vapor interfacial traction per unit length that involve wetting and capillary action [16-17]. Wenzel equation (1936) incorporated real area of contact in the form of surface roughness useful for prediction of surface tension at interphase contact [18-19]. The Wenzel regime is valid for homogeneous wetting as the liquid penetrates into the asperities to increase the surface roughness or evolution of vapor pockets reservoir whereas for heterogeneous wetting Cassie-Baxter model is preferred in surface science for assessment of surface tension [29-24]. The more surface tension of dynamic water molecules (2-4 times) than Teflon coating in cooking environment, entrapping of water molecules with rough void over surface, and hydrodynamic radial movement under thermal loadings of aerosols in amalgamation of environmental molecules at “TRIBO” junction might provide non-stick performance (Table 1).

Expression	Keywords
Transformation of friction from conventional engineered surface to soft tribology such as tactile interface of electronic devices e.g., Android phones, e-commerce, and household devices	Industrial revolution

Mechanoreceptors on touchscreen displaying tactile feedback from modulation of mechanical effort into electronic signals invincible in consumer electronics at sticking and slipping tribological domain	***Electroadhesion***
Impact of environment chemistry at rubbing interface for influencing tribological performance such as moisture and third body particles adsorption on engineered surface for haptic devices in a spectrum of real work with virtual world	***Environment chemistry***
Surface asperities and textured skin for higher micro-scale roughness for measuring the friction coefficient as small as 0.035 with friction coefficients between 0.34 and 0.45 for sample of tactile perception	***Friction coefficient***
Tribology of soft engineered polymers such as Polyethylene terephthalate (PET) belonging to thermoplastic polyester family provide excellent performance due to physiochemical properties, thermal stability, and optical transparency in application	***PET***
Teflon 18 mN/m, Polypropylene 29 mN/m, Polyethylene 31 mN/m, Polyvinyl alcohol (PVA) 37 mN/m, Polyvinyl chloride (PVC) 39 mN/m, Nylon 46 mN/m low surface energy and surface tension substrates	***Surface energy and surface tension***
Relationship of wettability with surface roughness $Cos\ (\theta_W) = rCos\ (\theta_Y)$ where θ_W is Wenzel contact angle, θ_Y Young's contact angle, and *r* for surface roughness (r = 1 for smooth surface & r > 1 for rough surface)	***Wenzel Equation***
Surface energy increasing order of surface functional groups -CF_3<-CF_2H<-CF_2<-CH_3<-CF_3 for designing superomniphobic surfaces with contact angle >150^0 and low contact angle hysteresis	***Fluorocarbon***

Table 1 A synergistic expression of functional surfaces, interfaces, and interphases for designing and manufacturing of mechanochemical materials at the forefront of sustainable development goals for reducing environmental reactions

3. Conclusions

The tactile friction of modern life at natural soft textured surface with engineered surface for protecting against environmental degradation, durability, electromechanical performance, and impact strength altogether encourage bionic design and manufacturing. The effective absorption of fuel energy or oral tribology and food processing may produce from non-stick cookware as a function of surface area and energy assessment of high protein/low carbohydrates/minimum vegetable oil requirement consumption during non-stick tribology. Teflon coatings is an ultrafunctional materials of low surface energy and surface tension for providing non-stick cookware of oleophobic soft surface.

Author Contribution

Author wrote paper by inclusion of a few author preprints

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Conflict of Interests

None conflict of interests to declare

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