

Conférence invitée

Sustainable Surface Engineering: Green Tribology Lessons from Squamate Reptiles

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Green tribology is an emerging branch of tribological sciences. It emphasizes balance between the engineering of rubbing assemblies, and the sustainability of natural resources. Thus it aims to reduce the global consumption of energy through adopting eco-compatible design, and application practices, capable of minimizing the friction-induced energy losses. The main scope of green tribology is, therefore, the development of technology rooted in natural engineering. Accordingly, three focus areas assume eminence due to potential impact on environmental issues. These are: Bio-inspired (bionic) self healing or self lubricating surfaces (and materials), Bio-degradable, environmentally friendly lubricants, and Tribo-sustainability of renewable energy sources. Fundamentally, customization of surface texture falls within the core of the main thrust areas.

Texture impacts the levels of friction and wear, it controls the quality and grade of lubricants, and it affects both the integrity and the net energy produced by any non-conventional renewable energy harvesting contraption. Current surface design paradigms result in principally in surfaces with random surface texture. Randomness, in essence, impedes the ability to control friction and wear and thereby results in higher degradation of natural resources. Natural systems, on the other hand, feature complex surface textures that comprise ordered multi-scale hierarchical components. Such a combination facilitates interactive tuning of friction and wear. Whence, building on the design concepts prevailing in the natural domain stands to advance the quest of engineering a new class of environmentally-synchronized surfaces [1]. That is, the manifestation of a class of surfaces with minimized ecological foot print. Such surfaces not only are of low friction and wear profiles but also are able to actively adjust their tribological response based on intrinsic metrological features. This paper discusses the process of texture design generation in natural systems with a focus on the essence of texture designs within the Serpentes suborder of Squamata.

Squamata comprises two large clades: Iguania and Scleroglossa. The later comprises 6,000 known species, 3100 of which are referred to as "lizards," and the remaining 2,900 species as "snakes". They are found almost everywhere on earth. Their diverse habitat presents a broad range of tribological environments. This requires customized response that manifests itself in functional practices and surface design features. The tribological performance of snakes manifests functional surface constructs where diverse ornamentation actively contributes to dynamic regulation of friction [2]. This feature, potentially, may inspire deterministic solutions for many surface customization problems faced in the technical world [3]. The talk will discuss the role of surface texture in: (i) transferring motion between the body of the snake and the substrate, (ii) generation of tractions and accommodation of motion through the skin, and how such control affects the effort invested in initiation of motion and thereby will also affect the function and the shape of the different parts of the skin (i.e., customization in tribo-design). Further the role of surface texture in controlling friction within this species will be detailed and design concepts which may be implemented to practical engineering surfaces will be outlined.

Références :

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