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Surface Functionalization with Polymers: Towards Biocompatible and Ecofriendly Lubrication of Engineering Systems

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Life-long maintenance of biotribosystems, such as synovial joints, ocular tracts, and oral cavity, is remarkable and even puzzling considering that the base stock for the lubrication is water. For most man-made engineering systems, water is generally excluded as lubricant due to its poor capabilities to withstand external loads on its own. Nature solves this problem by incorporating pressure-responsive, "smart coatings", such as mucus gel layers on the surface, and thus facilitate the entrainment and retainment of water (lubricant) at the rubbing interfaces [1]. Mucins, a family of high-molecular-weight glycoproteins and a main macromolecular constituent of mucus gels, are interesting also because they show unique slipperiness at the interface with synthetic materials too [2]. This, in turn, has inspired the development of mucin-like, brush-forming synthetic polymers, which can be applied in the lubrication of engineering materials with water [3]. Biophysical properties of both mucinous glycoproteins and their mimics, brush-forming polymers, are very sensitive to environmental changes, and this feature can be exploited to optimize their properties for particular applications. Presently, surface functionalization of soft matter at the rubbing interfaces appears as the most promising and practical means to achieve biomimetic and ecofriendly lubrication of engineering systems. This talk will provide an overview on recent researches on surface adsorption, functionalization, and triobological properties of various synthetic or biopolymers, including poly(ethylene oxide)(PEO)-based copolymers, polyeletrolyte-based copolymers, and mucins.

References

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