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Effect of surface texturing on the performance of artificial hip joint for Muslim prayer (Salat) activity

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Abstract

Currently, the artificial hip joint is the best option for total hip arthroplasty, and the demand for this procedure is increasing annually. However, a major deficiency of artificial hip joints is the performance limitation in a wide range of movements, such as those in Muslim prayer (salat), a major religious practice that consists of seven positions representing extreme movements. In this work, a numerical examination is conducted to investigate the performance of artificial hip joints with three texture configurations and with two different ball materials subjected to seven loading conditions of Muslim prayer (salat). Transient non-Newtonian elastohydrodynamic lubrication analyses are solved using the

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- Natural joints: Synovial joints, articular cartilage, meniscus, mechanically and biochemically induced damage
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- Prosthesis tribology: Prosthetic human interfacing and coupling, tribological function
- Biological implants: Catheters, heart pumps, stents, bio-probes, intravenous, needles
- Biomimetics: Bio-inspired tribology, insect tribology,
- Ocular tribology: Ocular surfaces, contact lenses, tear lubrication and Dry Eye Syndrome
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- Haptics: Tactile perception and surface texture, ergonomics
- Personal care: Hair conditioners, skin creams, cosmetics, shaving products, exfoliants, toothpaste
- Oral processing: Foodstuffs and beverages, mouth feel and taste perception, food texture and rheology
- Dental tribology: Tooth and implant wear, implant anchoring, tribo-corrosion of dental surfaces, fracture mechanism of teeth
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Biotribology
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Effect of surface texturing on the performance of artificial hip joint for Muslim prayer (Salat) activity

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Highlights

- The 3D CFD-FSI model of soft-on-hard hip joint prostheses has been successfully simulated.
- The surface texture has beneficial effects on the lubrication performance under certain Muslim prayer (salat) activity.
- The 11-13% load support improvement is observed.
- The alumina femoral head gives a better result compared to the stainless steel one.

Abstract

Currently, the artificial hip joint is the best option for total hip arthroplasty, and the demand for this procedure is increasing annually. However, a major deficiency of artificial hip joints is the performance limitation in a wide range of movements, such as those in Muslim prayer (salat), a major religious practice that consists of seven positions representing extreme movements. In this work, a numerical examination is conducted to investigate the performance of artificial hip joints with three texture configurations and with two different ball materials

ScienceDirect

Biotribology
Volume 26, June 2021, 100161

Imparting ultralow lubricity to double-network hydrogels by surface-initiated controlled radical polymerization under ambient conditions

Kaihuan Zhang, Rok Simic, Nicholas D. Spencer

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Highlights

- A high-modulus, double-network hydrogel with a cartilage-mimicking, highly lubricious polymer-brush coating.
- μ for a PMETAC brush-covered PAMPS/P(AAm-DMAPMA) double-network hydrogel against glass in water is 0.001-0.004 (1-10 N load).
- A large variety of different polymer brushes can be grown from a PAMPS/P(AAm-DMAPMA) DN hydrogel under ambient conditions.

Abstract

Hydrogels, especially double-network hydrogels, are attractive candidates as load-bearing biomaterials, e.g., tissue-engineering supports for articular cartilages and bones. In this study, we describe the modification of a double-network hydrogel by the introduction of a third monomer, *N*-[3-(dimethylamino)propyl]methacrylamide, to the network system, which serves as a reactive site for subsequent interfacial reactions and surface-initiated controlled radical polymerization under ambient conditions. The as-prepared poly(2-(methacryloyloxy)ethyl trimethylammonium chloride) (PMETAC) polyelectrolyte polymer brush-modified DN hydrogel exhibited an ultralow coefficient of friction (0.001–0.004) under high contact pressure—comparable to that of the synovial joint.

ScienceDirect

Biotribology
Volume 26, June 2021, 100164

Substrate Roughness Induced Wear Pattern in Gastropod Radulae

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Highlights

- Introducing experimental set-up involving sandpapers for determining the contact area between the gastropod's feeding organ and its ingesta.
- These experiments under controlled conditions reveal distinct sandpaper-induced facets.
- Comparisons of the tooth material loss led to the determination of the contact areas and the amount of teeth involved in the feeding process, both directly related with the surface roughness.
- This contributes to our knowledge about the underlying mechanisms preventing structural failure in radulae.

Abstract

Determining a precise contact area between one surface and another surface is essential for understanding tribological tool performance, since this area contributes to the force transmission. Radular teeth are part of the complex molluscan feeding apparatus acting on the ingesta by transmitting muscle-driven forces, in some cases working as a puncturing tool. Various approaches aimed at identifying the contact areas and cutting edges of

ScienceDirect

Biotribology
Volume 26, June 2021, 100163

Simultaneous Characterization of Implant Wear and Tribocorrosion Debris within its Corresponding Tissue Response Using Infrared Chemical Imaging

Songyun Liu [a b], Deborah J. Hall [a], Craig J. Della Valle [a], Michael J. Walsh [c], Joshua J. Jacobs [a], Robin Pourzal [a]

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Highlights

- Use of FTIR-I for the direct identification of fine XLPE debris accumulation within macrophages.
- Detection of chromium phosphate debris with periprosthetic tissue in case with modular junction fretting corrosion.
- Chemical characterization of histopathological patterns with FTIR-I unveil biochemical alteration of periprosthetic tissue.
- Assessment of the complex nature of implant debris through the characterization of particle-laden macrophages.

Abstract

Biotribology is one of the key branches in the field of artificial joint development. Wear and corrosion are among fundamental processes which cause material loss in a joint biotribological system; the characteristics of wear and corrosion debris are central to determining the in vivo bioreactivity. Much effort has been made elucidating the debris-induced tissue responses. However, due to the complexity of the biological environment of the artificial