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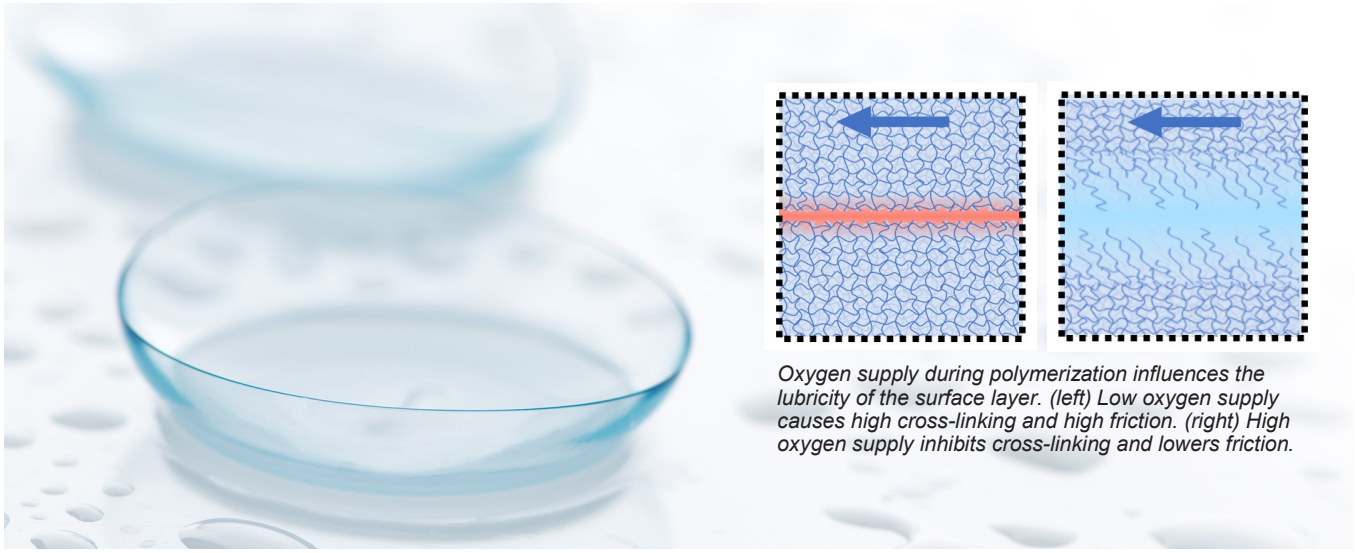
Licensing Opportunity

Controlling the lubricity of hydrogels in soft contact lenses and other sliding-gel applications



Oxygen supply during polymerization influences the lubricity of the surface layer. (left) Low oxygen supply causes high cross-linking and high friction. (right) High oxygen supply inhibits cross-linking and lowers friction.

Application

A fabrication method and tool allow the production of hydrogels with tailored lubricity. Products such as contact lenses, condoms, catheters or transdermal drug-delivery patches can be optimized with respect to their friction properties.

Features & Benefits

- One-step fabrication
- Easy incorporation of lubricity gradients
- Enables surface patterning

Publications

- R. Simič, N.D. Spencer, “Controlling the Friction of Gels by Regulating Interfacial Oxygen During Polymerization”, Tribology Letters (2021), 69:86 https://doi.org/10.1007/s11249-021-01459-1
- Patent pending

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Reference 2020-115

Technology Readiness Level

Background

Hydrogels are typically shaped in moulds. The surface properties are adjusted in a second fabrication step, which tunes the friction for a specific application. Functionalizing the gel surface directly in the mould could reduce the number of fabrication steps and the ability to localize different areas with distinct frictional properties opens new possibilities for applications.

Invention

The degree of cross-linking of the polymer chains at the surface of hydrogels defines their lubricity and, thus, the friction of the hydrogel when sliding over a surface (e.g. skin). The degree of cross-linking can be adjusted by controlling the available amount of molecular oxygen during polymerization. Oxygen leads to cross-linking being inhibited more strongly than chain propagation, resulting in long, dangling, lubricious polymer chain-ends at the hydrogel surface. When the mould controls the oxygen supply, the lubricity of the contact surface can be tailored during polymerization, while the hydrogel bulk remains unchanged. The walls of moulds can be made from oxygen-permeable materials (e.g. PE foils). By adjusting the oxygen atmosphere around the mould, a controlled amount of oxygen can be supplied to the polymerization reaction. Spatial patterns of different lubricity can be introduced by modifying the permeability of the mould in predefined areas. Also, designed gradients in lubricity properties can be produced on the gel surface. Another possibility is lining the mould with an oxygen-enriched layer, which releases the oxygen during polymerization. For example, oxygen-enriched PE layers can be added to the mould in regions, specifically where higher lubricity is desired.