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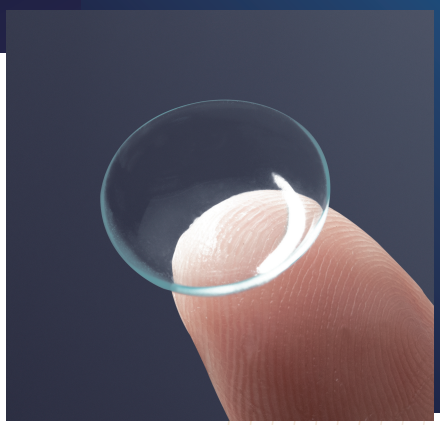
3.3s Advanced Optometric Technologies

CEVR Centre for Eye and Vision Research 眼視覺研究中心

The Hong Kong Polytechnic University 香港理工大學 | University of Waterloo

Development of New-Generation Contact Lenses Using Novel Materials and Additive Manufacturing



3D printed contact lenses

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Aims

To combine advanced material design with state-of-the-art 3D printing technology to enable the affordable production of personalized and/or specialized contact lenses with a sustained ocular drug delivery feature through on-demand manufacturing.

Background

Traditional hydrogel contact lenses, although widely used, often lack advanced capabilities for effective drug delivery and long-term durability, limiting their utility beyond basic vision correction. Silicone hydrogel contact lenses were developed to improve oxygen permeability, flexibility, and durability, making them more suitable for extended wear. However, integrating reliable drug delivery systems into these lenses remains challenging. The emergence of 3D printing technology has introduced new possibilities for creating customized hydrogel structures for medical applications.

Work to be Done

To overcome current limitations, 3D-Printable Hydrophilic Silicone Elastomers will be designed to enhance the durability, comfort, and drug delivery capabilities of contact lenses. Our approach utilizes a single-step ink formulation and in situ gelation for rapid photopolymerization, enabling high-resolution (10-micron) 3D printing with mechanical stiffness ranging from 100 kPa to 10 MPa. By integrating silicone with hydrophilic side chains and acrylate monomers within a semi-interpenetrating polymer network, we aim to create a material with high water content, mechanical resilience, and long-term stability—essential for both vision correction and ocular drug delivery.

Benefits

The breakthrough in elastic and durable hydrogel polymers for ocular drug delivery and vision correction will revolutionize eye care, providing immediate benefits for individuals with refractive error. These advanced specialty contact lenses, designed for personalized fitting and superior oxygen permeability, will offer an unparalleled combination of comfort, precision, and convenience—surpassing traditional corrective lenses. By integrating cutting-edge materials and technology, this innovation will redefine vision enhancement, ensuring healthier eyes and improved quality of life for millions worldwide.

Impact

These innovations will significantly enhance the quality of life for individuals with visual disabilities, such as glaucoma, macular degeneration, and diabetic retinopathy, through sustained drug-release contact lenses. This advancement is expected to reduce the number of eye operations while increasing the availability of drug-delivery lenses, benefiting both patients and the healthcare industry. Additionally, the commercialization of these novel materials will drive economic growth and sustainability by establishing a new industry.

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