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Polysaccharide Hydrogel Optical Fibers for Biomedical Applications

Stanford inventors have developed and fabricated biodegradable and biocompatible polysaccharide hydrogel optical fibers for fiber optic sensing and light transmission in biomedical applications like antigen detection, tracking cellular events, and optogenetics.

Optical transmission of information with fiber optic devices has revolutionized communication and sensing technologies in nearly every scientific field and industry. However, the application of fiber optics to biomedical applications has been limited by the low biocompatibility of silica, the material used for fabricating classical glass optical fibers.

In this work, Stanford inventors have developed polysaccharide-based optical fibers that are biocompatible but also share many of the favorable characteristics of traditional silica fiber optic systems, like the ability to be repaired or connected after fabrication with fusion splicing methods. These optical fibers have a host of applications in medicine and bioscience ranging from biosensing of biotargets like viral antigens to photonics and optogenetics. This invention has the potential to bring the fiber optics revolution, finally, into the biotechnology realm.

Applications

- Swab-coupled biotarget sensing via encapsulated nanoparticles (tested in detection of SARS-CoV-2 antigens)
- Light delivery and imaging in biological tissues for optogenetics and other biomedical device applications
- Fast, non-destructive, Anti-cancer drug testing (tested in highly metastatic prostate cancer cell lines)

Advantages

- Fully biodegradable and biocompatible (enables introduction of cells in the active light-guiding optical fiber compartment)
- Dynamic core crosslinking allows for repair and connection by fusion splicing and easy doping
- High water content, low density meshes allow biomacromolecule diffusion including viruses for detection
- First 3D plasmonic based swab-coupled sensing platform
- First Living Optical Fibers where biological microtissues (e.g., cancer) can grow and be screened using light

Publications

- Guimarães, Carlos F., et al. "Engineering Polysaccharide-Based Hydrogel Photonic Constructs: From Multiscale Detection to the Biofabrication of Living Optical Fibers." *Advanced Materials* (2021): 2105361.

Patents

- Published Application: WO2022226357
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Innovators

- Utkan Demirci
- Rui Reis
- Rajib Ahmed
- Carlos Guimaraes

Licensing Contact

Seth Rodgers

Licensing Manager, Life Sciences

Email