Silk-based optical waveguides meet biomedical needs

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There is a growing need for biocompatible photonic components for biomedical applications - from in vivo glucose monitoring to detecting harmful viruses or the telltale markers of Alzheimer's. Optical waveguides are of particular interest because of their ability to manipulate and transport light in a controlled manner in a variety of configurations.

In an article featured on the cover of Advanced Materials, researchers at Tufts University and the University of Illinois at Urbana-Champaign demonstrated a new method for fabricating silk-based optical waveguides that are biocompatible, biodegradable and can be readily functionalized with active molecules. The Tufts-UIUC team successfully demonstrated light guiding through this new class of waveguides created by direct ink writing using Bombyx mori silk fibroin inks.

"In many biomedical applications, waveguides must interface directly with living cells and tissues, requiring the waveguide constituent to be biocompatible. Biodegradability is also desirable," said Tufts' Fiorenzo Omenetto, professor of biomedical engineering in the School of Engineering and professor of physics in the School of Arts and Sciences. "The use of a biocompatible, biodegradable polymer like silk to guide light opens up new opportunities in biologically based modulation and sensing along with an opportunity to integrate light delivery within living tissue."

The research capitalized on Tufts' knowledge of silk-based biopolymers and biophotonics and the expertise of UIUC Professor Jennifer A. Lewis and graduate student Sara T. Parker in direct-write assembly to create complex planar and three-dimensional structures.

"Silks are well suited for this purpose, because they are the strongest and toughest natural fibers known," said David Kaplan, professor and chair of the biomedical engineering department at Tufts' School of Engineering. "Furthermore, the ability to biochemically functionalize or incorporate dopants into the silk-fibroin ink allows for unconventional photoactivation of the waveguides, which is not easily achieved otherwise."

Direct ink writing is a simple, inexpensive technique that does not require harsh processing steps. A computer-controlled three-axis translation stage precisely moves a syringe barrel that houses a viscous ink, which is extruded from a fine deposition nozzle under pressure. The ink flows rapidly through the nozzle, and equally rapidly solidifies upon exiting to retain a filamentary shape while maintaining sufficient optical clarity to guide light.

More information: "Silk Fibroin Waveguides: Biocompatible Silk Printed Optical Waveguides" appeared in the June 19, 2009, issue of *Advanced Materials*, authored by Sara T. Parker, Peter Domachuk, Jason Amsden, Jason Bressner, Jennifer A. Lewis, David L. Kaplan, and Fiorenzo G. Omenetto.

Source: Tufts University