Nanofibers for Probing Hazardous Liquids (2012-024)

Nanoporous Nanofibers Wick Small Volume Hazardous Liquids for Subsequent Analysis

Market Overview

These porous nanofibers are designed to collect extremely small volumes of liquid for analysis, featuring materials that control liquid uptake by a butterfly-type proboscis. The global nanofibers market had an estimated worth of $390.6 million, and is expected to grow at over a 25% CAGR between 2016 and 2024 due to the ever-expanding application space. Sampling of hazardous chemicals or liquids at the cellular level presents a challenge for both safety and sensing capabilities. The ability to deploy, detect, sample, and identify low-volume fluids in a single microfluidics device could be a promising technology with many engineering applications. Clemson University researchers have developed a method of creating nanofibers with the critical materials features of a butterfly proboscis, incorporating the desired aspects to detect and collect potentially hazardous low-volume liquids in a safe manner.

Technical Summary

The artificial proboscis is fabricated using a library of electrospun polymer fibers. By controlling the time of electrospinning and revolution rate during the twisting of the fibers into yarn, biomimetic transport and mechanical properties comparable to a butterfly proboscis can be obtained. By varying the chemical composition of polymer blends and environmental conditions during electrospinning, a porosity as high as 82% can be achieved. The absorption rate of the probes is significantly increased by designing the probes to have double porosity composed of both micrometer- and nanometer pores. Depending on the application, the probe can be made ferroelectric or magnetic for remote manipulation to collect droplets. Remote bending of the probes is affected by the absorbed material, allowing the probes to act as identifiers/sensors themselves.

Application

Low-volume liquid collection/detection; Extracting biofluids

Development Stage

Preliminary Prototype

Advantages

- Nanofibers possess ordered bands, allowing for proboscis-like fluid transport
- Porosity of the probes is adjustable, providing control over how much liquid can be absorbed and the rate of liquid uptake and wicking
- Nanofiber probes can be made ferroelectric or magnetic, enabling remote manipulation to absorb droplets

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	13/611,971	9,383,292	2012-024	Dr. Konstantin Kornev

About the Inventor

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Dr. Konstantin Kornev obtained his Ph.D. in Physics and Mathematics from Kazan State University in Russia in 1988. In 1990 he was invited to join the Institute for Problems in Mechanics in Moscow, the leading institution of the Russian Academy of Sciences in the field of mechanics. In 2000 he joined the Textile Research Institute in Princeton, NJ, and in 2006 he joined the Department of Materials Science and Engineering in Clemson University. In 2013, he won the award for Outstanding Faculty Achievements in Science of the College of Engineering and Science of Clemson University. He was the 2016 President of the Fiber Society and the 2017 Theodore von Karman Fellow of RWTH Aachen University of Germany. His research expertise lies in advanced materials, biomechanics of insects, and the magnetics of nanocomposites.

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