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“Mechanically Switchable Polymer Fibers for in vivo Sensing”

Abstract:

The area of in vivo sensing using optical fibers commonly uses materials such as silica and polymethyl methacrylate (PMMA), both much stiffer than human tissue. The mechanical mismatch between material and living tissue has been seen to cause higher levels of glial encapsulation, scarring and inflammation leading to failure of the implant. We present the use of polyvinyl alcohol (PVA), a cheap, easy to work with, easily functionalized polymer, that undergoes a transition from rigid to soft when introduced to water, for use as an implantable sensor. This ability to mechanically switch creates a softer, more compatible material for the body thereby reducing the severity of the immune response. The method by which this softening is achieved also allows for the exterior and interior surfaces to act as sensing regions since an analyte is able to permeate into the fiber. In this paper, PVA was labeled with fluorescein and spun into fibers to be used in sensing applications. The resulting fibers showed excellent response to various stimuli as well exhibiting the desired mechanical switchability. For the dry fibers, a tensile storage modulus (E’) of approximately 4700 MPa was found which fell sharply to about 145 MPa upon wetting. The fibers also showed excellent response to decreasing pH levels producing values that were easily detectable in a range consistent with those seen in literature and desirable in proposed applications. The resulting fibers show that these mechanically switchable fibers are viable option for future sensing applications.

Biosketch:

Sean McMillan is seeking his Masters degree in MSE under the advisement of Dr. Johan Foster. As an undergraduate, he double majored in Chemistry and Biology at Radford University graduating in 2012. After working for two and half years as a Research Technician looking at medical diagnostics kits, he returned to academics to pursue a graduate degree in Materials Science Engineering. Sean’s research focuses on polymers with biomedical applications.