

Fabrication of highly sensitive, disposable and biodegradable SERS biosensor platforms from electrospun zein nanofibers

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Back ground: The vast number of biosensors that are fabricated to detect toxins and pathogens brings up the concern for plastic and synthetic material build-up in the environment and necessitates the use of more eco-friendly and green biosensors. In this study, a natural corn polymer, zein, is converted into a disposable surface enhanced Raman spectroscopy (SERS) biosensor platform in the form of electrospun fibers. First, the fabrication of the zein nanofibers were optimized for solvent use, polymer concentration and surface wettability. The surface of the nanofibers were then decorated with gold, silver, silver-shelled-gold, or a mixture of gold and silver nanoparticles at four different particle concentrations (1010, 1011, 1012, 1013 particles/ml) to optimize the sensitivity. The highest SERS enhancement factor of 2.49×10^6 was obtained with silver-shelled-gold nanoparticles at a concentration of 1012 particles/ml, which is the highest enhancement factor ever reported for a protein-based biodegradable platform. Decorated zein nanofiber platforms were then used to detect acrylamide, which is a carcinogenic food toxin often found in roasted or fried foods. The limit of detection for acrylamide was 2.06 ng/mL, which is 104 times lower than what was achieved with a previously fabricated zein film-based SERS platform (Gezer et al., 2016). Additionally, FAO/WHO reported the lowest levels of GC-MS and LC-MS/MS detection of acrylamide as 5-10 ng/mL and 20-50 ng/mL, respectively, which are above the limit of detection of this study. This new green and disposable zein-based nanofiber mats show great potential to become the next renewable alternative for non-biodegradable biosensors.

Biography

Hazal Turasan received her PhD degree from the Department of Food Science at Purdue university. She is currently continuing her postdoctoral studies in the Department of Biomedical Engineering at Purdue. Mukerrem Cakmak received his PhD degree from the Department of Polymer Engineering at University of Tennessee, Knoxville. He was one of the founders of Polymer Engineering Department at University of Akron where he was named Harold A. Morton Chair and Distinguished Professor of Polymer Engineering. He was also the founding director of the National Polymer Innovation Center. Dr. Cakmak is currently at Purdue University as the Reilly Professor of Materials and Mechanical Engineering. Jozef Kokini received his PhD degree from the Department of Chemical Engineering at Carnegie-Mellon University.