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The application of nanoparticle optical fiber sensors in the diagnosis of bacterial infections

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Rapid, culture-free, highly sensitive and specific assays are needed to diagnose bacterial infections. We have developed a nanoparticle optical fiber sensor (NOFS) that consists of a fiber with self-assembled nanoparticle film coatings bound to monoclonal antibodies (MAb) or DNA specific to methicillin-resistant *Staphylococcus aureus* (MRSA), the select agent *Brucella abortus,* or the bovine pathogen *Histophilus somni*. Ionic self-assembled multilayer (ISAM) films provide exposed positive or negative functional groups for conjugation of antibodies or DNA. Optical fibers with long-period gratings (LPG) enhance adsorption of ISAMs to the fiber cladding. MAb or biotinylated DNA specific to each bacterium were conjugated to the LPG-ISAM, which is connected to a small light source, spectrophotometer, and computer. Any substrate binding to the fiber results in attenuation of the transmitted light, including specific antigen or complementary DNA. Using a MAb specific to MRSA, as few as 100 MRSA cells could be detected, but greater than 10^6 methicillin-sensitive *S. aureus* (MSSA) cells were nonreactive. MRSA, but not MSSA, could also be detected from swabs of infected tissues from experimentally challenged mice. When the ISAM/DNA probe was exposed to $2.9x10^2$ cells of *Brucella* or $1x10^2$ cells of *H. somni* without PCR amplification, light transmission declined by 11.6 or 9.4%, respectively. In contrast, exposure of the ISAM/probe to 10^5 cells of *Escherichia coli* reduced light transmission by <0.9%. Therefore, the NOFS assay utilizing either MAb or DNA can detect specific pathogens in less than one hour with high sensitivity and specificity and without the need for PCR.

Biography

Thomas J. Inzana completed his Ph.D. at the University of Rochester School of Medicine and Dentistry, and postdoctoral work in an American Board of Medical Microbiology-approved program at Baylor College of Medicine. He holds the Tyler J. and Frances F. Young Chair in Bacteriology at Virginia Tech, is the director of the Clinical Microbiology Laboratory for the Virginia-Maryland Regional College of Veterinary Medicine Teaching Hospital, and is a fellow of the American Academy of Microbiology. He has published more than 100 peer-reviewed manuscripts in respected journals and has served on multiple editorial boards and grant review panels.

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