Rutgers University

MZO Nanostructure-Modified Bulk Acoustic Wave Biosensor for Dynamic and Rapid Determination of Antimicrobial Efficacy and Resistance

We propose to develop the magnesium zinc oxide (MZO) nanostructure - modified bulk acoustic wave (BAW) diagnostic device for rapid, sensitive, low-cost, and reliable detection and characterization of antimicrobial resistance (AMR). Antimicrobial drugs have greatly reduced infection-related illness and death, however, the extended use of antibiotics causes microorganisms to become adapted to these drugs through genetic alterations, giving rise to antimicrobial resistance (AMR). AMR threatens to become the next pandemic (World Health Organization 2014) and is becoming a major global-health concern according to the US Centers for Disease Control (CDC). However, the currently available conventional methods employed in screening antimicrobial susceptibility heavily rely on monitoring the growth of live microbial cells. The monitoring of the antimicrobial activty is typically handled through manually intensive essays and is time consuming (can take days even weeks for conclusive results). The nucleotide amplification or PCR-based approach to detect the presence of AMR genes is rapid, but it is indirect, not always correlates with AMR, needs expensive instruments and involves thermal-sensitive reagents, which is not appropriate for use at point-of-care. Here, we propose to develop a multifunctional and integrated AMR monitoring biosensor using an inexpensive and new technology that directly and rapidly detects antimicrobial drug activity and the emergence of AMR. Our preliminary results have demonstrated proof-of-principle, and high speed and sensitivity in bacterial/fungal detection for the sensor device. Further development of the technology will help drastically improve the timely decision-making on proper drug treatment, and more importantly, prevent the spread of antibiotic resistant strains. Our diagnostic device can be used in clinical microbiology laboratories, hospitals/healthcare centers, and antimicrobial research and develop settings. We anticipate that this disruptive new technology will significantly improve treatment for infected patients and surveillance for AMR pathogens.