Materials Day

Abstract Guide

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Label-free Rapid Antimicrobial Susceptibility Testing with Machine-learning Based Holography Enhanced Speckle Imaging

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Abstract: Antimicrobial resistance (AMR) poses a significant threat to global health, necessitating rapid and sensitive antimicrobial susceptibility testing (AST) methods. Traditional AST techniques, such as disk diffusion and gradient diffusion assays, require extended incubation periods, delaying critical treatment decisions. This study introduces a Dynamic Holographic Laser Speckle Imaging (DhLSI) system, coupled with machine learning, to rapidly assess bacterial susceptibility to antibiotics. Our approach captures variations in motility of bacteria under antibiotic exposure through holographic speckle patterns. With holographic detection, AST can be performed at a bacterial concentration of 10^3 CFU/mL, significantly enhancing the sensitivity and bypassing the need for overnight incubation. The integration of machine learning enables precise and rapid AST within 2-3 hours. Additionally, rapid bacterial identification using surface-enhanced Raman spectroscopy (SERS) in liquid samples is investigated with minimal sample preparation. Our method demonstrates robustness across multiple bacterial strains and antibiotics, providing a promising tool for early-stage infection diagnosis and better management of antibiotic use.