Identifying Bacteria with "Fingerprints" Based on Laser Diffraction Patterns

Chapman, Katarina

The prevailing identification and diagnosis of bacteria species requires the shipment of temperature-sensitive biological samples to a microbiology laboratory for biochemical, genetic or immunological analysis. Despite their high sensitivity, these methods are time consuming, need high quality machines and qualified scientists, which makes them expensive. Even fast methods such as real-time PCR pose obstacles, including the requirement of additional information about the bacteria. A fast, low-cost and non-destructive optical method was therefore developed as a potential way to respond faster to an epidemic, based on the identification of bacteria colonies grown on clear agar plates. The system contains a green helium-neon laser (543.5 nm), a digital camera and an adjustable mounting stage. Experiments were conducted with seven bacteria species from the morphological groups coccus and bacillus, which were alternatively grown 12 h or 48 h. The laser was focused onto a single colony, consisting of millions of densely packed bacteria and extracellular material, and the resulting diffraction pattern was used to determine the characteristics of the bacteria species. Since the laser interrogates the whole volume of the colony, 3-D information of micro- and macro-structures were encoded in the diffraction pattern. I investigated the connection between the morphological parameters of a bacterial colony, these being thickness, diameter and the individual bacteria shape, and the corresponding diffraction patterns. After collecting a database of patterns, it was possible for a non-expert to unambiguously identify bacteria species.

Awards Won: