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Application of multimodal surfaces using amorphous silicon (a-Si) thin film for secondary ion mass spectrometry (SIMS) and laser desorption/ionization mass spectrometry (LDI-MS)

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We reported that amorphous silicon (a-Si) thin film provide sample plate exhibiting a multimodality to measure biomolecules by secondary ion mass spectrometry (SIMS) and laser desorption/ionization mass spectrometry (LDI-MS). Kim et al.1 reported that a-Si thin film were suitable to detect small molecules such as drugs and peptides by SIMS and LDI-MS. Recently, bacterial identification has been required in many fields such as food analysis, veterinary science, ecology, agriculture, and so on.2 Mass spectrometry is emerging for identifying and profiling microbiology samples from its advantageous characters of label-free and shot-time analysis. Five species of bacteria – S. aureus, G. glutamicum, B. kurstaki, B. sphaericus, and B. licheniformis – were sampled for MS analysis without lipid extraction in sample preparation steps. The samples were loaded onto the a-Si thin film with a thickness of 100 nm which did not only considered laser-beam penetration but also surface homogeneity. Mass spectra were recorded in both positive and negative ionization modes for more analytical information. High reproducibility and sensitivity of mass spectra were demonstrated in a mass range up to mass-to-charge ratio(m/z) 1200 by applying the a-Si thin film in mentioned above MS. Principle component analysis (PCA) – a popular statistical analysis widely used in data processing was employed to differentiate between five bacterial species. The PCA results verified that each bacterial species were readily distinguished and differentiated effectively from our MS approach. It shows a new opportunity to rapid bacterial profiling and identification in clinical microbiology. More details will be discussed in the presentation.

Keywords: LDI-MS, SIMS, multimodality, bacteria, PCA

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The diameter and direction of jumping droplets from condensing water on lotus leaves

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Recent publications reported the self-propelled jumping of coalescing dew droplets on superhydrophobic surfaces [1-2]. We further investigated the initial growth, coalescence, and removal by self-propelled ejection of nano and microscopic water droplets on the superhydrophobic surface of lotus leaves under condensing conditions. By using a high-speed digital camera mounted on an optical microscope, we have found: (1) sub-micrometer droplets form and grow on nanoscale waxy hairs; (2) growing droplets coalesce rapidly upon contact, but never jump off the surface unless the diameter of merged droplets exceeds ∼15 μm; (3) the diameter and direction of jumping droplets are very narrowly distributed, centered at 20-30 μm and ∼20 degrees from the surface normal, respectively. We present a rationale for these observations on the basis of: (a) the hierarchically rough surface structure on nano- and micro-scales; (b) its chemical composition; and (c) the balance among competing forces of cohesion (surface tension), adhesion and gravity.

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Keywords: lotus, superhydrophobic, dewetting, droplet condensation, self-cleaning.