Special Seminar

Diagnosis of Infectious Diseases by Ion Mobility Mass Spectrometry

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There is a projection of 10 million deaths per year by 2050 due to antimicrobial resistance, highlighting the need for rapid detection and accurate identification of microorganisms. Therefore, developing fast robust diagnosis techniques will increase the recovery rates of patients suffering from various infections and will lead to significantly reduced antibiotic resistance. The membrane of bacteria contains varying lipid compositions that can be utilized as diagnostic biomarkers for disease. However, full characterization of lipids remains analytically challenging due to their enormous structural diversity and complexity (e.g., varying acyl chain positions and/or double bond geometries). This presentation will demonstrate the advantages of interfacing liquid chromatography and structurally based ion mobility with tandem mass spectrometry in the resolution of isomeric lipids. Moreover, this presentation will demonstrate our recent developments of ambient ionization techniques when coupled to high-resolution ion mobility spectrometry; we used the paper spray technique coupled with ion mobility separation and tandem mass spectrometry (PS-IM-MS/MS) to rapidly discriminate and identify five Bacillus species in 2 minutes of analysis time after only 4 hours of incubation time. Bacterial cells were harvested by filtering their liquid cultures and ionized directly by PS. Numerical multivariate statistics (principal component analysis, followed by linear discriminant analysis) allowed species-level discrimination with a prediction rate of 99.7% and 100% utilizing the negative and positive ion information of PS-IM-MS/MS, respectively. Next, we examined the capability of our methods to achieve strain-level differentiation of seven E. coli strains. Using numerical data fusion of negative and positive ion PS-IM-MS/MS data increased the classification rates of PS-IM-MS/MS to 80.5%. Upon using LC-IM-MS/MS, a prediction rate of 96.1% and 100% utilizing the negative and positive ion information, respectively could be achieved.

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Speaker Bio

Dr. Ahmed Hamid is an Assistant Professor in the Department of Chemistry and Biochemistry at Auburn University. He received his PhD degree in Physical Chemistry from Virginia Commonwealth University in 2012 under the supervision of Prof. Samy El-Shall. He did postdoctoral research with Prof. Graham Cooks at Purdue University from 2012-2014 and at Pacific Northwest National Laboratory with Dr. Richard D. Smith from 2014-2017. He was a Senior Scientist at MOBILion Systems, Inc. from 2017 to 2019 before joining Auburn University in fall 2019. Dr. Hamid's research is focused on the development of novel mass spectrometry instruments, in particular those utilizing ion mobility separations for several applications in clinical and environmental research areas.

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