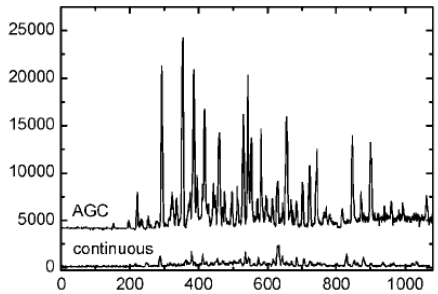
Mass Spec Finds its Sensitive Side

EMSL researchers take mass spectrometry to the next level

Users of the Department of Energy's EMSL have developed improved mass spectrometry (MS) tools that detect peptides with ten times more sensitivity. Diverse applications of this new technology to environmental and biological research include human health and homeland security.



Peak intensity for S.oneidensis *MS measurements is greater in the AGC mode, demonstrating higher sensitivity of detection.*

The research team from Pacific Northwest National Laboratory upped the ante for MS by adding an electrodynamic ion funnel trap (IFT) with automated gain control (AGC) to a conventional time-of-flight (TOF) MS system, allowing for optimized ion control. The first step to MS analysis is to generate ions by electrospray ionization; ions are then fed to a TOF MS for mass and charge analysis. Because the MS is typically coupled with another analytical tool (reversed-phase capillary liquid chromatography), ions are not generated at a constant rate, and the concentrations of ions passed to a TOF MS from an ion trap may exceed the TOF MS optimal detection range. By adding IFT with AGC to a conventional TOF MS system, the team was able to control the concentration of ions, minimizing the possibility of TOF MS detector saturation. In addition, ion accumulation in the IFT with AGC drastically improved signal-to-noise ratios for low-concentration analytes as compared to conventional TOF MS analysis.

To test the effectiveness of the IFT AGC modification, the team analyzed the proteome of *Shewanella oneidensis*, a bacterium that can chemically modify and neutralize toxic metals without apparent harm to itself. Compared to conventional techniques, the team's new and improved MS tool gave rise to ten times more sensitivity and greater mass measurement accuracy for analysis of low-concentration samples, yielding five times as many *S. oneidensis* unique peptides with the AGC mode (383 peptides) than with the conventional continuous mode of operation (73 peptides).

Scientific impact: Higher-sensitivity MS resources are the gateway to new discoveries in biological and environmental research. Data from next-generation MS tools can be used to refine computational models, benefiting EMSL's goal to predict biological functions from molecular and chemical data.

Societal impact: Societal benefits enabled by next-generation MS tools are diverse. One example is biomarker discovery and high-sensitivity biomarker detection, which will allow researchers to detect disease in its early stages, identify new pharmaceutical targets, and test for agents that may threaten homeland security.

For more information, contact EMSL Communications Manager Mary Ann Showalter (509-371-6017).

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