New cell for mass spectrometer speeds accurate ion identification

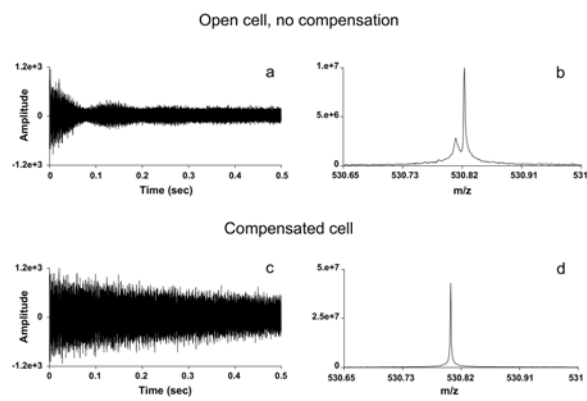
Theoretical studies lead to innovative design

Whether studying proteins to identify methods for less invasive medical tests or discover hydrocarbons for new energy sources, scientists need instruments that provide reliable, accurate measurements. A new trapped-ion cell, designed and developed at the Department of Energy's EMSL, provides a two-fold improvement in mass accuracy. This increased accuracy allows scientists to more confidently analyze highly complex mixtures and distinguish between nearly identical molecules in samples.

The cell, designed by scientists from Pacific Northwest National Laboratory, is being used on several proteomics research projects in combination with EMSL's 12-Tesla Fourier transform ion cyclotron resonance mass spectrometer.

The scientists began by studying the theories underlying FTICR and the accuracy obtained. Critical to the success of this mass spectrometry technique is the cell where the ions are trapped and excited. The new design generates an electrostatic trapping potential, responsible for holding the ions, that closely approaches the theoretical ideal. The new cell allows for higher signals and thus increased sensitivity and dynamic range. Experimental characterization of the new cell confirmed that a more homogeneous electrostatic trapping field improves the FTICR's performance.

Scientific impact: Using a more homogenous electric field in the FTICR, the cell provides a two-fold increase in ion characterization. This work supports studies at EMSL to predict biological functions from molecular and chemical data.



Peptide ions, coherently excited, induce a current on two detection plates using a conventional open cell (top left) and the new cell (bottom left). The more the ions are excited, the closer they get to the detection plates which should increase the measured signal. However, in the open cell (top right), non-ideal electric fields distort the ion motion, resulting in peak splitting, reduced mass measurement accuracy, and reduced sensitivity. The more theoretically ideal electric fields in the new cell enable ions to be excited closer to the detection plates with significantly less distortion of the ion motion improving sensitivity (peak amplitude), dynamic range, and mass measurement accuracy. These improvements will result in more peptides (and therefore more proteins, especially less abundant proteins) being identified with greater confidence.

Societal impact: Highly accurate information on proteins and other ions supports the underlying science necessary to solve intractable environmental, health, and energy challenges.

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

Citation: Tolmachev AV, EW Robinson, S Wu, H Kang, NM Lourette, L Pasa-Tolić, and RD Smith. 2008. "Trapped-Ion Cell with Improved DC Potential Harmonicity for FT-ICR MS." *Journal of the American Society of Mass Spectrometry* 19(4):586-97.

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