

New technology enables molecular-level insight into carbon sequestration

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Flaviu Turcu co-invented a novel NMR system for carbon sequestration research applications with EMSL staff, David Hoyt (Principal Investigator) and Jesse Sears, and PNNL colleagues, Jian Zhi Hu and Kevin Rosso. Turcu, pictured above, holds the high-pressure MAS rotor and stands behind the high-pressure rotor loading reaction chamber pieces of the system.

Carbon sequestration is a potential solution for reducing greenhouse gases that contribute to climate change, but its scientific challenges are complex. Analytical tools are needed that provide information about the mineral-fluid interactions of carbon dioxide (CO₂) at the molecular level.

As part of Pacific Northwest National Laboratory (PNNL)'s Carbon

Sequestration Initiative, a team of EMSL and PNNL researchers developed and patented such a tool—a unique high-pressure magic angle spinning (MAS) nuclear magnetic resonance (NMR) capability that operates in conditions characteristic of geologic carbon sequestration.

Described in the September 2011 issue of the *Journal of Magnetic Resonance*, this new technology consists of a reusable high-pressure MAS rotor, a high-pressure rotor loading/reaction chamber for in situ sealing and reopening of the high-pressure MAS rotor, and a MAS probe with a localized radiofrequency coil for background signal suppression.

This new capability can help determine reaction intermediates and final products that occur during mineral dissolution reactions relevant to the geologic disposal of CO₂, as these researchers reported in the July 2011 issue of the *International Journal of Greenhouse Gas Control*.

Identifying reaction intermediates is not possible using only ex situ measurements and is critical to determining the mechanisms of mineral dissolution at high pressures. This new capability has the potential to further the exploration of solid-state chemistry at new levels of high pressure and temperature in many science areas.

More information: References: Hoyt DW, RVF Turcu, JA Sears, KM Rosso, SD Burton, AR Felmy, and JZ Hu. 2011. “High-pressure Magic Angle Spinning Nuclear Magnetic Resonance,” *Journal of Magnetic Resonance*, [DOI:10.1016/j.jmr.2011.07.019](https://doi.org/10.1016/j.jmr.2011.07.019)

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