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A diamond-window XAFS cell for studies of high-temperature, high-pressure aqueous solutions

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Supercritical water (SCW) is an interesting solvent for chemical reactions and hazardous waste destruction. At temperatures above 375°C, the solubility behavior of two important classes of compounds reverse: most organic species have high solubility whereas the solubility of inorganic salts is limited. The high solubility of organics and the aggressive oxidizing environment is attractive for organic reactions and waste-destruction reactions. A better understanding of the mechanism of salt solubility in SCW is required to fully utilize this unique solvent. We describe a method to collect x-ray absorption fine structure (XAFS) spectra of ions in a supercritical water solvent.

The XAFS cell was composed of a block of high-nickel alloy, Hastelloy C-22, containing two windows for transmission of the x-ray beam and a single optical view window. All internal wetted surfaces were platinum plated. The maximum operating conditions for this design are 500°C and 700 bar. The x-ray transmission windows consisted of CVD (chemical vapor deposition) diamond windows (3 mm diameter x 0.5 mm thick) that were brazed to the tip of a standard 1/4-in. high-pressure, coned-shape fitting. Sample pathlengths were 6 mm. Spectra, acquired for strontium ions and krypton in supercritical water, will be reported.