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Investigating Sulfur Speciation in Biological Samples Using Medium Energy X-rays

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The medium energy x-ray range that spans ~2-5 keV covers the K-edge of important biological elements P and S, as well as important biological ions, Cl-, K+, Ca2+. This energy range fills the "gap" between energies typically accessed at soft x-ray or hard x-ray beamlines, The energy range is also referred to as the "tender" or "squishy" x-ray range, but regardless the name, this energy range is important to biology!
The wide range of oxidation states in which sulfur can exist facilitates many biological processes, and the thiol disulfide redox switch is a classic example. In addition, highly oxidised forms of sulfur, such as sulfonic acids (+4) and sulfates (+6) have important roles in biology.
Studying the chemical form of sulfur, "sulfur speciation" in biological systems is difficult. Few methods exist for direct detection of sulfur, and due to its redox active nature, sample preparation and assay protocols frequently modify sulfur oxidation state. For these reasons, x-ray absorption spectroscopy is an ideal technique, to directly investigate sulfur speciation in biological samples. In this presentation I will describe my work at international facilities of the last 5 years, using medium energy x-rays to access the sulfur K-edge (~2470 eV), to study sulfur speciation in a range of biological samples (brain tissue, cartilage tissue, and muscle tissue).

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