Biogenic manganese oxides: Raman spectroscopic studies of structure and reactivity

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The oxidation of Mn(II) catalyzed by microorganisms, especially bacteria, is orders of magnitude faster than abiotic Mn(II) oxidation. The resulting biogenic manganese oxide minerals, ubiquitous in soils and sediments, play a key role in the biogeochemical cycles of metals and organic compounds affecting the transport and fate of both contaminants and metals via catalytic and oxidative processes. However, little is known about the structure of these solid phase products. Raman spectroscopy, a technique sensitive to the short range environment of oxygen coordination around cations in oxide lattices, is being developed as a probe of Mn oxide structure, and the structure of surface adsorbates. Adsorbed molecules should be detectable because of the high surface areas of Mn oxides. Detailed studies of the xenobiotic degradation capabilities of these oxides under differing environmental conditions are being explored using Raman spectroscopy.