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Sulfides, Surfaces and Synchrotrons

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The physical and chemical properties of sulfide mineral surfaces and their interactions with aqueous environments and microbes, is crucial to minerals processing. Over the past 30 years surface analysis techniques including X-ray photoelectron spectroscopy (XPS), Auger Electron Spectroscopy (AES), Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS), Atomic Force Microscopy (AFM) and X-ray absorption Spectroscopy (XAS) have been used to elucidate the surface properties of sulfide minerals at selected stages during processing. Their use is now commonplace and has driven interest for further development of advanced in and ex situ nano-spectroscopic techniques.

Nanospectroscopic imaging techniques have provided the opportunity to investigate the effects of mineral heterogeneity and interaction of microbes on the distribution of surface chemical products during dissolution. A prototype Electrochemical Nanoreactor, for high resolution spectroscopic imaging in a hydrated and controlled electrochemical state has been developed and used to study the growth of Cu dendrites and the dissolution of pyrite and chalcopyrite in the presence of Af. The results support the preferential attachment of bacteria to pyrite and the modification of its surface with polysaccharides. The technique shows promise for applications in in-situ geomicrobiological and electrochemical research.

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