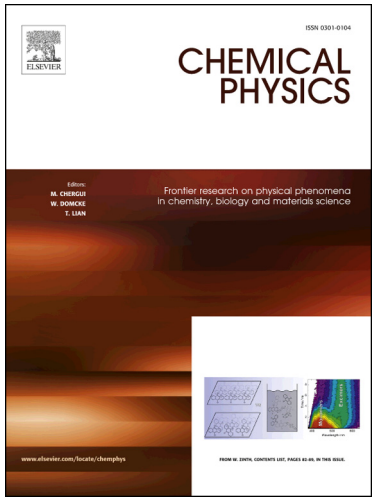

Spectroscopic study of cystine adsorption on pyrite surface: From vacuum to solution conditions

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Spectroscopic study of cystine adsorption on pyrite surface: From vacuum to solution conditions.

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Abstract

We characterized the adsorption of cystine molecules on pyrite surface via X-ray photoelectron spectroscopy. Anoxic conditions were simulated under ultra-high-vacuum conditions. In contrast, to simulate oxidation conditions, the molecules were adsorbed on pyrite surface from solution. A novel comparative analysis revealed remarkable differences with respect to molecular adsorption and surface chemistry induced by environmental conditions. Molecular adsorption under anoxic conditions was observed to be more favorable, concentrating a large number of molecules on the surface and two different chemical species. In contrast, the presence of oxygen induced an autocatalytic oxidation process on the pyrite surface, which facilitated water binding on pyrite surface and partially blocked molecular adsorption. Pyrite is a highly reactive surface and contains two crucial types of surface functional groups that drive molecular chemistry on the surface depending on the surrounding conditions. Therefore, the system explored in this study holds interesting implications for supporting catalyzed prebiotic chemistry reactions.

Keywords: Cystine; Pyrite surface; X-ray photoemission spectroscopy (XPS), reactivity, anoxic, oxidizing, minerals.