Competitive adsorption of oxalate and phosphate on maghemite

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Plant Exudates and Competitive Adsorption

Terrestrial plants have developed several mechanisms of phosphate uptake for their survival. One of the well-known mechanisms is a competitive adsorption of phosphates on the surface of the soil by exuding organic acids from plant roots [1]. Yet, the competitive mechanism of organic acids for the adsorption has not been fully understood. Therefore, we were motivated to elucidate the fundamental mechanisms of the competitive adsorption between phosphates and oxalates.

ATR-FTIR Measurement

We prepared the stock solution of 10mM oxalate and 10mM phosphate in a 0.1 M NaCl matrix at pH 4.5, and exposed maghemite film on ATR crystal to the solution. The spectra were measured by changing the pH.

The Structures of Adsorbed Oxalate

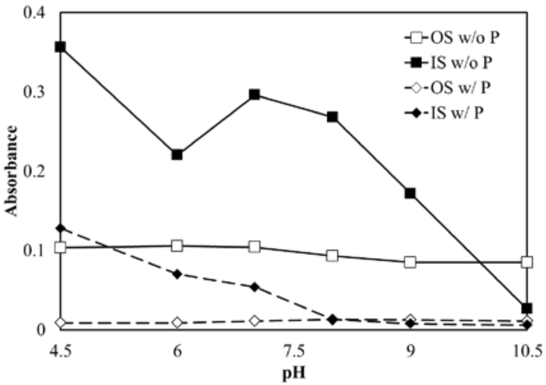

Figure 1: Absorbances of oxalate outer-sphere complex (OS, 1309 cm^{-1}) and inner-sphere complex (IS, 1682 cm^{-1}).

Outer-sphere (OS) and inner-sphere (IS) complexes appeared at 1309 cm^{-1} and 1682 cm^{-1}, respectively [2]. Due to competition with phosphates, IS and OS of oxalate decreased. This phenomenon could be explained by the high adsorption affinity of phosphate on maghemite. Moreover, the structure of oxalate complexes was not affected by the presence of phosphates. OS complex did not vary over the entire pH range, while IS complex decreased as the pH increased.

[1] Aulakh et al. (2001) Plant Biology **3**, 139-148. [2] Bhandari et al. (2010). Langmuir **26**, 16246–16253.