

有機ヒ素化合物の土壌中における吸着機構に関する研究 A study on the adsorption mechanism of organoarsenic compounds in soil

田中 雅人^{1*}, 高橋 嘉夫¹
Masato Tanaka^{1*}, Yoshio Takahashi¹

¹ 広島大学大学院理学研究科

¹ Graduate School of Science, Hiroshima University

Inorganic arsenic compounds are predominant cause of water-related disease of arsenic in natural systems. In addition, organoarsenic compounds, phenylarsonic acid (PAA) and diphenylarsinic acid (DPAA) were detected in well water, which is suggested to cause serious health problems in Kizaki region of Kamisu City, Japan [1]. These phenyl arsenic compounds are considered as a product of decomposition of chemical warfare agents during World Wars I and II. Recently, adsorption and mobility of these aromatic arsenic compounds in agricultural soils have been investigated [2]. However, their adsorption mechanisms on soil particles are still unknown. In general, the adsorption property of chemical compounds influences its migration process in natural environments such as soil-water system. Thus, it is important to understand the adsorption mechanism of the arsenic compounds to predict future fate of them in environment. In this study, we conducted As K-edge XAFS measurements and ab initio MO calculations for PAA and DPAA as well as methylarsonic acid (MMA) and dimethylarsenic acid (DMA) adsorbed on ferrihydrite, a strong absorbent of arsenic compounds, to determine their adsorption structures and understand the effects of substitution of organic functional groups on their adsorption. EXAFS analysis suggests that all organic arsenic compounds in this study form the inner-sphere complex with ferrihydrite regardless of the organic functional groups and the number of substitution. The As-Fe distances are ca. 3.25 Å which agree with the results of ab initio MO calculations. The coordination number (CN) of the As-Fe shell was less than 2 indicating the formation of bidentate structure which was reported for the adsorption of arsenate [3]. This fact implies that the ratio of monodentate structure increases due to steric hindrance.

References:

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