Adsorption behavior of Cu^{2+} on the surface of *Paenibacillus polymyxa*

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The microorganism can clearly affect the mobility of the metal ions in the environmental fluids because of the abundant chemical groups on the cell surfaces. Adsorption of ions on the microorganism surface generally plays important roles in various biogeochemical processes, such as mineralization, nucleation and crystal growth. In order to disclose the adsorption mechanism and obtain the adsorption capacity of bacteria, we experimentally studied the Cu^{2+} adsorption behaviors of a widely occurring bacterium, *Paenibacillus polymyxa*.

Firstly, a series of consecutive acid titration was carried out. The results show that the range of the optimum pH value favoring the adsorption of proton on the surface of *Paenibacillus polymyxa*, is 7.54 to 6.00. It is also recealed that the cell surface bears abundant negative charges, which potentially determines the ion adsorption capacity. Secondly, the Cu^{2+} adsorption isotherm of *Paenibacillus polymyxa* was experimentally obtained. The Cu^{2+} adsorption amount is acquired based on the difference in the solution concentration before and after the adsorption experiment, which was measured using ICP-AES. The fitting analysis of the isotherm data indicates that the biosorption process agrees well with both Langmuir model and Freundlich model in the range of equilibrium concentration $[Cu^{2+}]$ of environmental solution from 20×10^{-6}~1300×10^{-6}. According to the isotherm equation of Langmuir model, the calculated adsorption capacity of Cu^{2+} on cell surface is as high as 1.69×10^{-7} mg Cu/cell. Similar adsorption behaviors were also observed for the system involved strain *Steptomyces coelicolor* A3(2) and Cu^{2+}, Ni^{2+} [1], *Aeromonas caviae* and Cd^{2+} [2]. Furthermore, the pH of the solution increases linearly with the Cu adsorption amount increasing. It is deduced that ion exchange between surface H^+ and Cu^{2+} may be the potential mechanism of the apparent adsorption.

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^{81}Kr dating and ^{85}Kr dating

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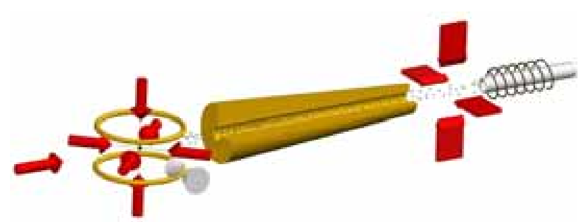
Atom Trap Trace Analysis (ATTA) has been used to analyze two rare isotopes: ^{81}Kr ($t_{1/2}$=229,000 yr, isotopic abundance ~10^{-12}) and ^{85}Kr ($t_{1/2}$=10.8 yr, ~10^{-11}), in environmental samples. ^{81}Kr dating can now be used to determine the ages of groundwater samples in the range of 50,000–1,000,000 years. The present apparatus (ATTA-2) has an overall counting efficiency of 0.01% and, for ^{81}Kr dating, requires a water sample of 1,000 liters. We are developing a new apparatus (ATTA-3) to laser-trap and count ^{81}Kr atoms with the goal of reaching a counting efficiency of 1%, which would reduce the required sample size down to 10 liters of water or ice. If successful, ATTA-3 will enable a wide range of applications in the earth sciences.



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