The *c*-type cytochromes in extra polymer substances dominate biological Cr(VI) reduction

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The extracellular electron transfer (EET) of metal-reducing bacteria, such as *Shewanella oneidensis* MR-1, play a key role to convert environmental metallic minerals and organic pollutants. Although researchs have recently reported that these microbial cells are surrounded by extra polymeric substances (EPS), the role of EPS in the EET process is poorly understood. In this study, we successfully acquired the extra polymer substances (EPS) of *Shewanella oneidensis* MR-1. Mass spectrometry results displayed the EPS contains two kinds of the outer membrane *c*-type cytochromes (OM *c*-Cyts), MtrC and OmcA. Electrochemical analysis demonstrated that the EPS exhibited redox properties. In addition, spectral results revealed the content of the *c*-Cyts in the EPS is significantly higher than that in the outer membrane. According to the redox transformation of the *c*-Cyts in the EPS and Cr(VI) reduction by reduced *c*-Cyts, the redox properties of the EPS was comprehesively examined. the kinetic results showed the Cr(VI) can be quickly reduced by the *c*-Cyts in the EPS, and the Cr(VI) reduction rates decreased gradually with increasing intial Cr(VI) concentrations. Therefore, the combination of all the data with the presence of electron transfer proteins within EPS suggests that EPS is redox active and play an important role in the extracellular Cr(VI) reduction processes. This study provides a new insight into the roles of EPS in the whole EET processes, and might improve the fundemental understanding of the biological metal reduction mechanisms.

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