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论文

HCO_3^-和SO_4^{2-}对Cu点蚀行为的影响

王长罡, 董俊华, 柯伟, 陈楠

中国科学院金属研究所金属腐蚀与防护国家重点实验室, 沈阳 110016

摘要： 在不同浓度配比的HCO_3^-和SO_4^{2-}混合溶液中, 利用循环极化电化学测试方法和 SEM, 对Cu工作电极的循环极化行为和点蚀表面形貌进行了系统的研究. 结果表明, 在高电位范围的循环极化实验中, Cu的点蚀行为可分为活性溶解型点蚀和钝化膜破裂型点蚀; 随SO_4^{2-}浓度的升高Cu点蚀的敏感性增大. 由于HCO_3^-与SO_4^{2-}的协同作用, 随HCO_3^-浓度升高点蚀敏感性呈先增大后减小的规律. 在钝化膜破裂型点蚀中, SO_4^{2-}提高Cu点蚀的诱发能力; HCO_3^-降低Cu点蚀的诱发能力. 2种离子对点蚀自修复能力的影响无明显规律.

关键词： 高放废物地质处置 Cu点蚀 循环极化 HCO_3 SO_4^{2-}

EFFECTS OF HCO_3^- AND SO_4^{2-} ON THE PITTING CORROSION BEHAVIOR OF Cu

WANG Changgang, DONG Junhua, KE Wei, CHEN Nan

State Key Laboratory for Corrosion and Protection, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016

Abstract: As a kind of clean, efficient and relatively safe energy, nuclear energy has been widely used around the world. The high-level radioactive waste generated in the nuclear has also become a major risk, so the disposal safety of high-level radioactive waste will be especially important. The strategy for disposal of high-level radioactive waste in China is to enclose the spent nuclear fuel in sealed metal canisters which are embedded in bentonite clay hundreds meters down in the bed-rock. The choice of container material depends largely on the redox conditions and the aqueous environment of the repository. One of the choices for the fabrication of waste canisters is Cu, because it is thermodynamically stable under the saline, anoxic conditions over the large majority of the container lifetime. For this advantage, some other countries (Canada, Sweden) have selected Cu as the material of nuclear waste container. However, in the early aerobic phase of the geological disposal the corrosion of Cu could take place, and the corrosion behavior of Cu would be influenced by the complex chemical conditions of groundwater markedly. Pitting corrosion of Cu often take place in power plants or air--conditioning condensate water. The corrosion environment usually contains HCO_3^-, SO_4^{2-} and Cl^- ions. In the early stage of geological disposal, if the aerobic water with HCO_3^-, $SO_4^{2-}$and Cl^- immersion repository, the pitting corrosion of Cu may occur. The content of HCO_3^- and SO_4^{2-} in the water chemistry environment, as well as the synergy between them, could affect the behavior of pitting seriously. In this work, the cycle polarization behavior and surface morphology of pitting has been investigated in HCO_3^- and SO_4^{2-} mixed solution, respectively by electrochemical cyclic polarization test and SEM. The results showed that the pitting corrosion behavior of Cu can be divided into the type of active dissolve and the type of film rupture; SO_4^{2-} could increase Cu pitting sensitivity in both of the two types pitting corrosion. Due to synergies with the SO_4^{2-}, HCO_3^- could increase the pitting susceptibility first and then reduce the law. In passive film rupture pitting system, SO_4^{2-} could improve the ability of induce pitting; HCO_3^- could reduce the ability of induce pitting. There is no significant impact on pitting self--healing capacity by the two ions.

Keywords: high-level radioactive waste Cu pitting cyclic polarization HCO_3^- SO_4^{2-}

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通讯作者: 董俊华

作者简介: 王长罡, 男, 1985年生, 博士生
通讯作者E-mail: jhdong@imr.ac.cn

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