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氧化硫硫杆菌作用下黄铜矿-MnO_2同时发电浸出的机制

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摘 要： 采用双电池体系研究发电浸出过程和生物发电浸出过程中放电量、Fe^{2+}和Mn^{2+}浸出率与时间的关系。结果表明：生物发电浸出的Cu^{2+}和Fe^{2+}浸出率比单纯发电浸出提高近2倍，发电量和Mn^{2+}浸出率提高近3倍。对发电浸出产物进行XRD和SEM分析表明，经历发电浸出过程，晶体的形貌与反应前相似，发电浸出产物单质硫和杂质PbS大量存在；经历生物发电浸出过程，杂质PbS被氧化成$PbSO_4$，沉积在残渣表面。对氧化硫硫杆菌作用下$CuFeS_2$-MnO_2发电浸出机制研究表明，黄铜矿的发电浸出和生物发电浸出都存在表层的黄铜矿离解产生Cu^{2+}、Fe^{2+}和单质硫的过程，而生物发电浸出中还进行了单质硫部分被*A. f*菌氧化的后续过程，且生物氧化过程为控制步骤。MnO_2的浸出在本研究的系统中是被动的，如果黄铜矿的浸出还能进行，MnO_2的浸出就能持续。

关键字： 黄铜矿；二氧化锰；生物氧化；发电浸出

Electro-generative mechanism for simultaneous leaching of chalcopyrite-MnO_2 in presence of *Acidithiobacillus thiooxidans*

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Abstract: A dual cell system was used to study the relationship between time and electric quantity, dissolved Cu^{2+}, Fe^{2+} and Mn^{2+} ratio in the process of electro-generative simultaneous leaching (EGSL) and bio-electro-generative simultaneous

leaching (BEGSL). The results show that the dissolved Cu^{2+} and Fe^{2+} ratios in BEGSL are increased by almost 2 times, and the dissolved Mn^{2+} ratio and the electric quantity output in BEGSL are nearly 3 times more than those in EGSL. The oxidation debris for chalcopyrite characterized by XRD and TEM indicate that the crystal pattern is similar to that of the raw ore in EGSL. The impurity PbS is oxidized to insoluble $PbSO_4$ in BEGSL. The reaction mechanism of $CuFeS_2$-MnO_2 in the presence of *Acidithiobacillus thiooxidans* (*A. thiooxidans*) could be supposed as a successive reaction of two independent sub-processes. The stage both in EGSL and in BEGSL is the dissolution of chalcopyrite on the surface to Cu^{2+}, Fe^{2+} and sulfur; and the accumulated sulfur is oxidized by *A. thiooxidans* in the following procedure in BEGSL. The latter is controlling step in BEGL. The leaching of MnO_2 in this system is dependent on the leaching of chalcopyrite. If the reaction of chalcopyrite can be performed, the reaction of MnO_2 will continue.

Key words: chalcopyrite; MnO_2; bio-oxidation; electro-generative leaching

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