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**Sandoval et al.**

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(54) **METHOD AND APPARATUS FOR ELECTROWINNING COPPER USING THE FERROUS/FERRIC ANODE REACTION**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 185 days.

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(57) **ABSTRACT**

The present invention relates, generally, to a method and apparatus for electrowinning metals, and more particularly to a method and apparatus for copper electrowinning using the ferrous/ferric anode reaction. In general, the use of a flow-through anode—coupled with an effective electrolyte circulation system—enables the efficient and cost-effective operation of a copper electrowinning system employing the ferrous/ferric anode reaction at a total cell voltage of less than about 1.5 V and at current densities of greater than about 26 Amps per square foot (about 280 A/m<sup>2</sup>), and reduces acid mist generation. Furthermore, the use of such a system permits the use of low ferrous iron concentrations and optimized electrolyte flow rates as compared to prior art systems while producing high quality, commercially saleable product (i.e., LME Grade A copper cathode or equivalent), which is advantageous.

(52) **U.S. Cl.** ..... **205/576; 205/574; 205/586**

(58) **Field of Classification Search** ..... None  
See application file for complete search history.

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**20 Claims, 3 Drawing Sheets**

