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**Marsden et al.**

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(54) **PROCESS FOR MULTIPLE STAGE DIRECT ELECTROWINNING OF COPPER**

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**C25C 1/12** (2006.01)

(52) **U.S. Cl.** ..... **205/580; 205/574; 205/581; 205/584; 205/585; 205/586**

(58) **Field of Classification Search** ..... **205/574, 205/580, 584, 586, 581, 585**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,066,520	A	1/1978	Emmett, Jr. et al.	
5,622,615	A	4/1997	Young et al.	
6,451,089	B1 *	9/2002	Marsden et al. ....	75/744
6,663,689	B2 *	12/2003	Marsden et al. ....	75/744
6,676,909	B2 *	1/2004	Marsden et al. ....	423/28
6,972,107	B2 *	12/2005	Marsden et al. ....	266/171
2002/0044899	A1 *	4/2002	Marsden et al. ....	423/28

(Continued)

OTHER PUBLICATIONS

PCT—International Search Report, Mailing Date: Apr. 24, 2006.

(Continued)

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(57) **ABSTRACT**

A system and process for recovering copper from a copper-containing ore, concentrate, or other copper-bearing material to produce high quality cathode copper from a leach solution without the use of copper solvent/solution extraction techniques or apparatus. A process for recovering copper from a copper-containing ore generally includes the steps of providing a feed stream containing comminuted copper-containing ore, concentrate, or other copper-bearing material, leaching the feed stream to yield a copper-containing solution, conditioning the copper-containing solution through one or more physical or chemical conditioning steps, and electrowinning copper directly from the copper-containing solution in multiple electrowinning stages, without subjecting the copper-containing solution to solvent/solution extraction prior to electrowinning.

**19 Claims, 3 Drawing Sheets**

