



US006746656B2

(12) **United States Patent**  
**Khan et al.**

(10) **Patent No.:** **US 6,746,656 B2**  
(45) **Date of Patent:** **Jun. 8, 2004**

(54) **METHODS FOR PRODUCTION OF MOLYBDENUM CARBIDE**

(75) Inventors: **Mohamed H. Khan**, Tucson, AZ (US);  
**Joel A. Taube**, Donnellson, IA (US)

(73) Assignee: **Cyprus Amax Minerals Company**,  
Phoenix, AZ (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 162 days.

(21) Appl. No.: **10/007,349**

(22) Filed: **Nov. 7, 2001**

(65) **Prior Publication Data**

US 2003/0086857 A1 May 8, 2003

(51) **Int. Cl.<sup>7</sup>** ..... **C01B 31/34**

(52) **U.S. Cl.** ..... **423/345; 423/440; 502/177**

(58) **Field of Search** ..... **502/177, 182; 423/345, 414, 439, 440**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

2,402,084 A	6/1946	Rennie	
3,077,385 A *	2/1963	Robb	423/440
4,331,544 A *	5/1982	Takaya et al.	502/177
4,515,763 A	5/1985	Boudart et al.	
4,851,206 A *	7/1989	Boudart et al.	423/409
6,042,370 A	3/2000	Weide	
6,207,609 B1	3/2001	Gao et al.	502/177

**FOREIGN PATENT DOCUMENTS**

EP 1088788 A2 4/2001  
EP 1162281 A1 12/2001

**OTHER PUBLICATIONS**

Search Report in corresponding EPO Patent Application Serial No. 02022648.6-2122 of Cyprus Amax Minerals Company.

"Molybdenum Carbide Catalysts; II. Topotactic Synthesis of Unsupported Powders," Lee, J. S., et al., 6113 Journal of Catalysis, vol. 112 (Jul. 1988), No. 1, pp. 44-53.

Studies in Inorganic Chemistry 19, "Molybdenum: An Outline of its Chemistry and Uses" by E.R. Braithwaite and J. Haber, 1994, pp. 14-15, 25-26, 73-75, 147, 148, 150.

\* cited by examiner

*Primary Examiner*—Steven Bos

*Assistant Examiner*—Anthony Kuhar

(74) *Attorney, Agent, or Firm*—Bruce E. Dahl; Dahl & Osterloth L.L.P.

(57) **ABSTRACT**

Methods for producing molybdenum carbide. An embodiment of the method may comprise heating a precursor material in a first heating zone in the presence of a reducing gas and a carbonizing gas, the first heating zone having a first temperature. Moving the precursor material into a second heating zone to form the molybdenum carbide from the precursor material, the second heating zone having a second temperature, the second temperature being at least 100° C. hotter than the first temperature.

**19 Claims, 3 Drawing Sheets**

