US007470648B2

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

(10) **Patent No.: US 7,470,648 B2**
(45) **Date of Patent: Dec. 30, 2008**

(54) **REFORMING CATALYSTS**

(75) Inventors: **Yong Wang**, Richland, WA (US); **Jianli Hu**, Kennewick, WA (US); **Ya-Huei Chin**, Richland, WA (US); **Robert A. Dagle**, Richland, WA (US); **Chunshe Cao**, Kennewick, WA (US)

(73) Assignee: **Battelle Memorial Institute**, Richland, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1284 days.

(21) Appl. No.: **10/076,880**

(22) Filed: **Feb. 13, 2002**

(65) **Prior Publication Data**

US 2003/0153455 A1 Aug. 14, 2003

(51) **Int. Cl.**
B01J 23/02 (2006.01)

(52) **U.S. Cl.** **502/342**; 502/339

(58) **Field of Classification Search** 502/342, 502/343, 329, 333, 339; 423/651
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,177,219	A *	12/1979	Feinstein et al.	585/489
4,522,894	A	6/1985	Hwang et al.	429/17
4,596,782	A	6/1986	Courty et al.	502/302
4,613,584	A	9/1986	Schneider et al.	502/304
6,051,163	A	4/2000	Kumberger et al.	252/373
6,413,449	B1	7/2002	Wieland	252/373
6,576,588	B2 *	6/2003	Ryu et al.	502/331

FOREIGN PATENT DOCUMENTS

EP	0 278 749 A1	8/1988
EP	1 063 011 A1	12/2000
EP	1061011	12/2000
EP	1077081	2/2001
WO	WO 00/76651	12/2000

OTHER PUBLICATIONS

PCT International Search Report, no date.
JP 60082137 Abstract, 1985, no month.
"Partial Oxidation of methanol over supported palladium catalysts," Cubeiro, Applied Catalysis A. General, 168, 307-322 (1998), no month.
"Steam Reforming of methanol over Pd/ZnO: Effect of the formation of PdZn alloys upon the reaction," Iwasa, Applied Catalysis A: General, 125, 145-157 (1995), no month.
Chin et al., "Steam reforming of methanol over highly active Pd/ZnO catalyst," Catal. Today 77 (2002) 79-88.

* cited by examiner

Primary Examiner—Edward M Johnson
(74) *Attorney, Agent, or Firm*—Derek Maughan; Frank Rosenberg

(57) **ABSTRACT**

The present invention provides catalysts, reactors, and methods of steam reforming alcohols over a catalyst. Surprisingly superior results and properties obtained in methods and catalysts of the present invention are also described.

28 Claims, 7 Drawing Sheets