



US005403619A

United States Patent [19]

[11] Patent Number: **5,403,619**

Cuomo et al.

[45] Date of Patent: **Apr. 4, 1995**

- [54] **SOLID STATE IONIC POLISHING OF DIAMOND**
- [75] Inventors: **Jerome J. Cuomo**, Lincolnale, N.Y.;
Joseph E. Yehoda, Fogelsville, Pa.
- [73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.
- [21] Appl. No.: **6,343**
- [22] Filed: **Jan. 19, 1993**
- [51] Int. Cl.⁶ **C23C 16/22; B05D 3/06**
- [52] U.S. Cl. **427/248.1; 427/569; 427/355**
- [58] Field of Search **427/249, 355, 255.7, 427/255.3, 577, 569; 156/DIG. 68**

[56] References Cited

U.S. PATENT DOCUMENTS

- 4,540,452 9/1985 Croset et al. .
- 4,661,176 4/1987 Manasevit .
- 4,707,384 11/1987 Schachner et al. .

FOREIGN PATENT DOCUMENTS

- 59-215042 12/1984 Japan .
- 1-068484 3/1989 Japan .
- 01-71653 3/1989 Japan .
- 4-219400 8/1992 Japan .

OTHER PUBLICATIONS

Research Disclosure, Mar. 1989, No. 299, Kenneth Mason Publications Ltd., England, "Oxygen Content Control in Superconducting Oxides", E. A. Giess and E. J. M. O'Sullivan.

IBM Technical Disclosure Bulletin, vol. 15, No. 11, Apr. 1973, "Repairing Potential Gate Oxide Failure Sites and Development of 100% Defect-Free Gate Insulation", A. Bhattacharyya.

Materials Science and Engineering, B13 (1992) pp. 79-87, "Oxygen ion conductors and their technological applications", B. C. H. Steele, Centre for Technical Ceramics, Dept. of Materials, Imperial Col., London.

SPIE, vol. 1325, *Diamond Optics III* (1990), *Materials Research Lab., The Pennsylvania State Univ., University Park, Pa.*, pp. 160-167, "Infrared measurements of CVD

diamond films", X. H. Wang, L. Pilione, W. Zhu, W. Yarbrough, W. Drawl and R. Messier.

SPIE, vol. 1325, *Diamond Optics III* (1990), Tokyo Inst. of Technology, Dept. of Mechanical Engineering, Meguroku, Tokyo 152, Japan, pp. 210-227, "Development and performance of a diamond film polishing apparatus with hot metals", Masanori Yoshikawa.

SPIE, vol. 1325, *Diamond Optics III* (1990), Optical Sciences Center, Univ. of Arizona, Tucson, Ariz. 85721, pp. 142-151, "Diamond film polishing with argon and oxygen ion beams", Zhao Tianji, D. F. Grogan, B. G. Bovard, H. A. Macleod.

Appl. Phys. Lett., 60 (16), 20 Apr. 1992, American Inst. of Physics, pp. 1948-1950, "Massive thinning of Diamond films by a diffusion process", S. Jin, J. E. Graebner, G. W. Kammlott, T. H. Tiefel, S. G. Kosinski, L. H. Chen, and R. A. Fastnacht.

Diamond and Related Materials, 01 (1992) pp. 959-953, Elsevier Science Publishers B. V., "Polishing of CVD diamond by diffusion reaction with manganese powder", S. Jin, J. E. Graebner, T. H. Tiefel, G. W. Kammlott and G. J. Zydik.

Primary Examiner—Shrive Beck

Assistant Examiner—Bret Chen

Attorney, Agent, or Firm—Sterne, Kessler, Goldstein & Fox

[57] ABSTRACT

A process and apparatus for polishing diamond or carbon nitride. A reaction and polishing take place at the interface between an oxygen superionic conductor (yttria-stabilized zirconia) and the diamond or carbon nitride. Oxygen anions are transported to the interface under the influence of a chemical gradient and react with the diamond or carbon nitride. Other mechanisms, such as an electric field and/or heat, that increase the partial pressure of oxygen on the opposing side of the interface of reaction can be used to accelerate the reaction time. The process may be undertaken at low temperatures and without mechanical motion, making it an attractive and useful polishing method. In addition, there is no residue of the polishing process which needs to be removed and polishing can be accomplished in ambient air.

8 Claims, 5 Drawing Sheets

