US005318746A

United States Patent [19]

Lashmore et al.

[11] Patent Number: 5,318,746

[45] Date of Patent: Jun. 7, 1994

[54] PROCESS FOR FORMING ALLOYS IN SITU IN ABSENCE OF LIQUID-PHASE SINTERING

[75] Inventors: **David S. Lashmore**, Frederick; **John A. Tesk**, Highland, both of Md.; **Moshe P. Dariel**, Omer, Israel; **Edward Escalante**, Clarksburg, Md.

[73] Assignee: **The United States of America as represented by the Secretary of Commerce**, Washington, D.C.

[21] Appl. No.: **802,420**

[22] Filed: **Dec. 4, 1991**

[51] **Int. Cl.**[5] **B22F 1/02**; A61C 5/10

[52] **U.S. Cl.** **419/64**; 419/2; 419/8; 419/35; 419/47; 427/570; 75/955; 433/223; 433/229; 264/19; 205/80

[58] **Field of Search** 419/6, 35, 38, 39, 48, 419/49; 427/570; 205/80; 75/955; 264/19; 423/223, 229

[56] **References Cited**

U.S. PATENT DOCUMENTS

Re. 29,093	12/1976	Burns	264/111
3,004,332	10/1961	Werner	29/182.5
3,914,507	10/1975	Fustukian	428/404
3,933,961	1/1976	Burns	264/111
4,181,757	1/1980	Youdelis	427/229
4,218,507	8/1980	Deffeyes et al.	428/328
4,323,395	4/1982	Li	75/212
4,426,404	1/1984	Shoher et al.	427/2
4,664,855	5/1987	Tremblay et al.	264/111
4,742,861	5/1988	Shoher et al.	164/80
4,859,412	8/1989	Groll et al.	419/23
4,963,184	10/1990	Diehl et al.	75/247
4,970,050	11/1990	Groll et al.	419/36
4,990,394	2/1991	Shoher et al.	428/212
4,997,699	3/1991	Shoher et al.	428/212
5,064,690	11/1991	Sando et al.	427/215
5,118,317	6/1992	Wijner	445/50
5,183,631	2/1993	Kugimiya et al.	419/10

OTHER PUBLICATIONS

Goetzel, C. G., "Treatise on Powder Metallurgy", pp. 248–250, 1949, vol. 1, Technology of Metal Powder and Their Products.

Greener et al., "Dental Amalgams", *Dental Materials: Properties and Selection,* Quintessence Publishing Co., Inc., 1989, pp. 263–281.

Masuhara et al., "Study on Toxicity of a New Gallium Alloy for Dental Restorations", *Journal of Dental Health,* 27, p. 361, (1987).

T. Okabe, "Characterization of a Gallium Alloy for Dental Restoration", *Dental Material Abstract* No. 624.

Ishii et al., "The Primary Irritant Testing to the Human Skin of Gallium Alloy", *J. Fukuoka Dent. Coll.,* 14(1):96–112, 1987, p. 49.

H. Joujima et al., "Studies on Biological Evaluation of Gallium Alloy", *J. Fukuoka Dent. Coll.,* 14(3):249–257, 1987, p. 40.

Yoshida et al., "The Basic Study on Gallium Alloy for Restoration", *J. Fukuoka Dent Coll.,* 31(4):1004–1012, 1988, pp. 1004–1005.

Kim et al., "The Clinal Observation of Gallium Alloy as a New Dental Restorative Material for Primary Teeth", *J. Fukuoka Dent. Coll.,* 14(4):395–400, 1988, p. 56.

Primary Examiner—Daniel D. Wasil
Assistant Examiner—Daniel Jenkins
Attorney, Agent, or Firm—Fran Wasserman

[57] **ABSTRACT**

Oxide-free metallic, alloy or intermetallic compound formed by coating a powder of at least one member selected from the group consisting of elemental metallic, alloy and intermetallic compound with an oxide-replacing metal. The oxide-free compound may be compacted without the addition of a liquid sintering agent and at temperatures below the melting point of the compound, under sufficient pressure to form a uniform, consolidated intermetallic body.

16 Claims, 7 Drawing Sheets