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(54) **LOW-FRICTION SURFACE COATINGS AND METHODS FOR PRODUCING SAME**

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(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,479,289 A 11/1969 Van Wyk
3,845,008 A 10/1974 Mitchell
4,039,697 A 8/1977 Isawa et al.
4,599,110 A * 7/1986 Kohler et al. 75/243
4,966,749 A * 10/1990 Kondo et al. 419/10
5,089,222 A * 2/1992 Kondo et al. 419/10

5,314,714 A * 5/1994 Seeber et al. 427/62
5,332,422 A 7/1994 Rao
5,358,753 A 10/1994 Rao et al.
5,476,632 A 12/1995 Shivanath et al.
5,484,662 A 1/1996 Rao
5,538,684 A 7/1996 Luk et al.
5,702,769 A 12/1997 Peters
5,980,819 A 11/1999 Nakagawa et al.
6,376,103 B1 4/2002 Sampath et al.
6,395,202 B1 5/2002 Nagel et al.
6,623,876 B1 9/2003 Caron
6,689,424 B1 2/2004 Wang et al.
6,815,400 B2 11/2004 Jee et al.

(Continued)

FOREIGN PATENT DOCUMENTS

DE 102007029291 A1 12/2008
JP 10226833 A 8/1987

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion for PCT/US2011/041340, dated Oct. 27, 2011, 8 pages.

(Continued)

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(57) **ABSTRACT**

A coated article system includes a substrate and a surface coating on the substrate. The surface coating is formed by depositing individual particles of a composite metal powder with sufficient energy to cause the composite metal powder to bond with the substrate and form the surface coating. The composite metal powder includes a substantially homogeneous dispersion of molybdenum and molybdenum disulfide sub-particles that are fused together to form the individual particles of the composite metal powder.

34 Claims, 4 Drawing Sheets

