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(54) **COMBUSTION SYNTHESIS METHOD AND BORON-CONTAINING MATERIALS PRODUCED THEREFROM**

(75) Inventors: **Olivia A. Graeve**, Alfred, NY (US);
Raghunath Kanakala, Alfred, NY (US);
Gabriel Rojas-George, Chihuahua (MX)

(73) Assignee: **Board of Regents of the Nevada System of Higher Education, on behalf of the University of Nevada, Reno**, Reno, NV (US)

(56) **References Cited**
U.S. PATENT DOCUMENTS

4,260,525 A * 4/1981 Olsen et al. 252/521.1
5,376,421 A * 12/1994 Sekhar et al. 427/224
5,611,828 A * 3/1997 Celikkaya 51/309
5,647,988 A * 7/1997 Kawanishi et al. 210/636
2005/0029495 A1* 2/2005 Hubacek et al. 252/301.4 R
2005/0080175 A1* 4/2005 Paik et al. 524/418
2008/0268246 A1* 10/2008 Stark et al. 428/402
2009/0095604 A1* 4/2009 Johnson et al. 200/61.03

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FOREIGN PATENT DOCUMENTS

JP 2005-1918 * 1/2005
JP 2005 001918 * 1/2005
KR 2003071014 * 7/2003
KR 2003071014 * 9/2003
RU 2054377 * 4/1996
WO WO 90 14307 * 10/1990
WO WO 90 14307 * 11/1990

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* cited by examiner

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Primary Examiner — Curtis Mayes
Assistant Examiner — Bijay Saha
(74) *Attorney, Agent, or Firm* — Wood, Herron & Evans, LLP

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(57) **ABSTRACT**

(51) **Int. Cl.**
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One embodiment of the present disclosure provides a method of making a ceramic material that contains boron and a metal. A metal source, an oxidizer, a boron source, and a fuel source are combined. These reactants are then heated at, or to, a temperature sufficient to initiate a combustion reaction. The combustion reaction produces a ceramic material that includes boron and the metal. The present disclosure also provides materials formed by the disclosed method, as well as methods and systems using such materials.

(52) **U.S. Cl.**
USPC **423/276**; 423/289; 423/263; 423/297
(58) **Field of Classification Search**
None
See application file for complete search history.

19 Claims, 13 Drawing Sheets

