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MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
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(54) Title: COMPOSITE REACTIVE MATERIALS WITH INDEPENDENTLY CONTROLLABLE IGNITION AND COMBUS-
TION PROPERTIES

(57) Abstract: The present invention is directed to composite particles that react with a small and adjustable input energy. The igni-
tion threshold depends primarily upon reactant spacing and chemistry, not overall particle size. Combustion properties, such as burn
duration and temperature, are controlled by adjusting particle size or reactant composition. The best performance is achieved by se-
lecting reactants with strong intermetallic formation reaction and that combust in different phases (condensed vs gaseous). These
particles are fabricated by various methods, including physical vapor deposition, or ball milling. The concept of purposefully de-
coupling ignition and combustion properties by fabricating particles where ignition is determined by reactant spacing and/or com-
position and combustion is determined by adjusting particle size and/or composition is described. Combinations of specific react-
ants, such as Al, Zr, Ti, Mo, Mg, B, Li, etc. exhibit dual-phase combustion, and/or enhance combustion through prevention of ter-
minating species. Ternary additions are used to form gaseous species.



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B. FIELDS SEARCHED			
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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)			
EAPATIS, ESP@CENET, RUPTO, USPTO, WIPO, PAJ			
C. DOCUMENTS CONSIDERED TO BE RELEVANT			
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	
X Y	US 5339624 A (NOBELKRUT AB) 23.08. 1994, abstract, col.1-4, claims	1-7, 11-24 8-10, 18-21, 25-27	
X Y	WO 2014/207405 A1 (HERAKLES) 31.12.2014, abstract, p.7, lines 5-8, p.9, lines 12-36	1-2 25-27	
Y	US 5212343 A (MARTIN MARIETTA CORPORATION) 18.05.1993, abstract, col. 5, lines 5-27, examples 4-5, 13-16, claims 5, 8	8-10, 18-21	
A	CN 101239390 A (CHINA NATIONAL ACADEMY NANOTECHNOLOGY & ENGINEERING) 13.08.2008, abstract, description	1-27	
A	WO 2005/035939 A1 (QINETIQ LIMITED et al.) 21.04.2005, abstract	1-27	
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.			
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1279680 A (DYNAMIT NOBEL AKTIENGESELLSCHAFT) 28.06.1972, claim 2	1-27
A	RU 2443666 C1 (FEDERALNOE GUP FEDERAL NYJ NP TS NII PRIKLADNOJ KHM) 27.02.2012	1-27
A	US 7632364 B1 (JOUET RICHARD JASON. et al.) 15.12.2009	1-27