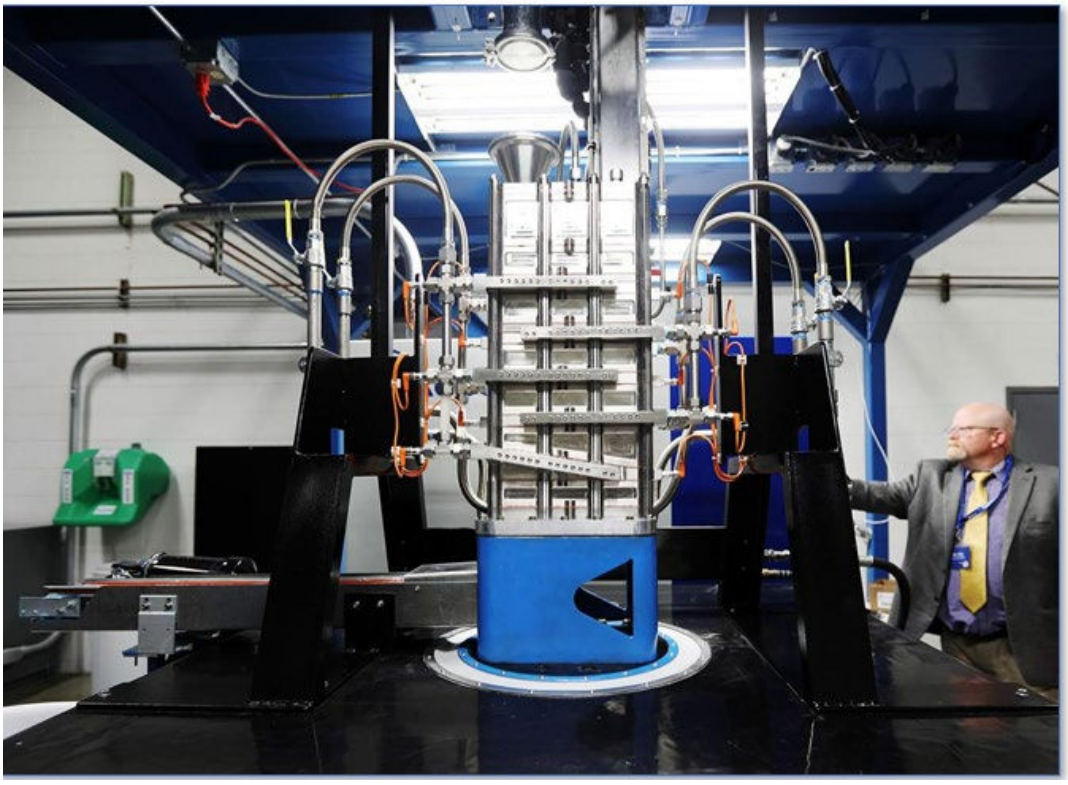
Resodyn™
ACOUSTIC MIXERS
Innovative Mixing Solutions

Game-Changing Innovation Enabled By ResonantAcoustic® Mixing Technology

Testimonials • Published Articles • Patents & Patent Applications



February, 2022

This document is a portfolio of testimonials, articles, and patents/patents pending that reference ResonantAcoustic® Mixing (RAM) technology in a variety of industrial mixing applications. This collection of abstracts and links to published articles provides insight into the value and impact of RAM as a means of solving material processing challenges, improving quality, and making organizations more efficient and profitable.

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The Game-Changing Value of RAM

What materials engineers, scientists and technicians do every day is rapidly changing our world for the better. ResonantAcoustic® Mixing (RAM) is at the forefront of many breakthrough innovations involving nanomaterials, pharmaceuticals, additive manufacturing, energy storage and dozens of other applications and industries. From development of leading-edge aeronautics and defense systems to the evolving capabilities of 3D printers, electric vehicles and life-saving medical devices, advances are made possible by the unique capabilities of RAM.

Professionals across the globe rely on RAM to change the way their industries think about mixing and processing.

Australia
Belgium
Canada
China
Czech Republic
Costa Rica
France
Germany
Greece
Hungary
India
Ireland
Israel
Italy
Japan
Latvia

Liechtenstein
Mexico
Netherlands
New Zealand
Norway
Puerto Rico
Saudi Arabia
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Turkey
Taiwan
United Kingdom

= Locations of customers of ResonantAcoustic® Mixers

What material processing professionals are saying about RAM

"[ResonantAcoustic Mixing] is a fantastic technology. It has revolutionized the way we mix for development of materials for additive manufacturing. Where RAM excels is at mixing pastes with high solids loading—that is, on the order of 80% solids and 20% liquid, or extremely viscous mixtures. We reduced mix times of highly viscous materials from five days to five minutes."

- Research & Development Manager
Ceramic Materials Developer

"Resonant acoustic mixers from Resodyn have proven to be extremely valuable in graphene development for our clients. It is critical for nanotechnologies such as graphene to be processed with the level of exacting consistency and particle distribution, especially at low loadings, that RAM has proven to consistently achieve."

- Research Scientist
European Nanomaterial Research Organization

"Today, six of our biggest projects all leverage RAM. To be honest, without RAM we wouldn't be where we are today. It created a whole new paradigm for us by safely and efficiently mixing energetic slurries we use in our automated loading processes…"

- Matthew Puszunski, Chief Operating Officer
Innovative Materials and Processes, Inc.

"[We] mix different rheologies with powder metals, highly viscous, and the LabRAM II has proven it can do that effectively. We're very impressed with the build quality of the mixer--it's a nice, solid, well-thought-out piece of equipment. It's done very well for us."

- Managing Engineer
Major U.S. Research Laboratory

"In [one] production-line product...the [QC sample] test time took on average from six to seven hours. We've demonstrated LabRAM will cut that down to 45 minutes. This is a huge game-changer for us. It has the potential to save us mountains of money because it saves us from producing a lot of bad product by catching it faster than ever before."

- Lab Supervisor
Global Synthetic Products Company

"The [LabRAM II] has yielded some surprising and exciting results for us. We actually made a new metal alloy [for additive manufacturing]. Acoustic mixing opens up the possibility of adding oxides or ceramics to any metal, which creates a huge design space that wasn't previously available."

- Materials Engineer
U.S. Government Agency

RAM: *The Industrial Mixing Technology of Choice*

Number of RAM systems sold for industrial materials mixing: **>1,000**
Number of countries RAM has been sold into: **33**

PUBLISHED ARTICLES
Additive Manufacturing

Icon Legend

RAM testing, evaluation

Liquid/powder

3D printing

Material/chemical properties

Materials processing

Additive manufacturing

Powder/powder

Materials/product quality

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereolithography	"The 3YZ inks were made using solids loading in PEGDA ranging from55 to 70 wt% (18–30 vol%, Table 2). The ink was mixed with spherical zirconia grinding beads (4mm diameter) in an acoustic mixer (LabRAM II, Resodyn Acoustic Mixers, Butte, MT) for 3h at 70 g-force to break up agglomerates and disperse the particles. The LabRAM II mixing time was determined by SEM images of the inks at different time points to ensure homogeneous dispersion... "	2021
	Feasibility of Cryomilled 17-4 Stainless Steel Powder as Feedstock for Additive Manufacturing	"...The blending process was carried out with a Resodyn LabRAM II acoustic mixer operating for 1 h with 10 g's of acceleration."	2020
	Efficient production of a high-performance dispersion strengthened, multi-principal element alloy	"To produce AM material, equiatomic NiCoCr medium entropy alloy (MEA) powder which exhibited a diameter size range between 10–45µm and Y2O3 particles rated between 100–200 nm were acquired. A Resodyn LabRAM II ResonantAcoustic™ mixer was employed to coat the NiCoCr powder with one weight percent of nanoscale Y2O3...[the LabRAM II] quickly homogenized the powder, eventually coating the larger NiCoCr powder with a thin film of Y2O3 after an hour of mixing in a polyurethane container..."	2020
	Additive manufacturing of ammonium perchlorate composite propellant with high solids loadings	"...20g batches of propellant were hand mixed in a 473 ml jar until the AP was wetted. The mixture was then placed into a [Resodyn Acoustic Mixers LabRAM] resonant mixer. The HTPB binder propellant was mixed for 3 min at 80g for three repetitions with further hand mixing between cycles while the UV binder propellant was mixed in the Resodyn Acoustic Mixer for 2 min at 80g for 30s followed by a rest period of 30s...the techniques demonstrated in this paper could be used to create a wide range of complex grain structures that were not previously possible to manufacture."	2019
	Additive manufacturing of carbon fiber reinforced silicon carbide solid rocket nozzles	"Suitable green body formulations were developed and tested prior to being printed. The final formulation was viscous enough to hold its shape during the 3D printing process so there was minimal deformation before the part was thermoset. 40 g batches were made in a Resodyn ResonantAcoustic™ mixer for three cycles of 3 minutes at 80g. The properties of the mixture did not vary over the course of a few days, making it printable within that time frame."	2019

PUBLISHED ARTICLES
Advanced Materials

Icon Legend

RAM testing, evaluation

Liquid/powder

Polymers, ceramics

Material/chemical properties

Materials processing

Nanomaterial

Powder/powder

Materials/product quality

Graphene

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	Resonant Acoustic Mixing Method to Produce Lipid-Based Liquid-Crystal Nanoparticles	"We have found that when compared to traditional sonication-based methods, the use of resonant acoustic mixing allows for large-scale synthesis of nanoparticle solutions and the formation of LLC nanoparticles of desirable sizes. We believe this new technique will facilitate the development of lyotropic mesophase materials and new methodologies for the fabrication of nanoparticles."	2021
	3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereolithography	"The [ceramic additive manufacturing] ink was mixed with spherical zirconia grinding beads (4 mm diameter) in a LabRAM II acoustic mixer for 3 h at 70 g-force to break up agglomerates and disperse the particles. The LabRAM II mixing time was determined by SEM images of the inks at different time points to ensure homogeneous dispersion..."	2021
	Resonant Acoustic Mixing Method to Produce Lipid-Based Liquid-Crystal Nanoparticles	"Compared to traditional sonication-based methods, the use of resonant acoustic mixing (RAM) allows large-scale synthesis of nanoparticle solutions and formation of LLC nanoparticles of desirable sizes...[RAM] will have a significant impact in shaping the future of nanoscience, providing a rapid and efficient mixing/fabrication platform for materials for cosmetics to therapeutics to vaccines."	2021
	Investigation of the impact of particle size on properties and applications of a ceramic slurry	"To make the ceramic slurry, 3YZrO2 nanoparticles were mixed with polyethylene glycol diacrylate (PEGDA Mn 575, Sigma Aldrich) and zirconia grinding media and mixed for 3 hours in a Resodyn™ LabRAM II acoustic mixer."	2019

* Article links may be limited by copyright restrictions. Detailed links on following pages.
^ Results excerpted/paraphrased from articles.

PUBLISHED ARTICLES

Advanced Polymers

Icon Legend

RAM testing, evaluation

Material/chemical properties

Powder/powder

Liquid/powder

Materials processing

Materials/product quality

Polymers

Graphene

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	A novel method for preparing stabilized amorphous solid dispersion drug formulations using acoustic fusion	"...A diverse set of drug and polymer combinations have been effectively evaluated utilizing a newly developed method called acoustic fusion to form amorphous solid dispersions (ASD) on the mg-scale, indicating that this approach is a general procedure that can be applied for ASD drug formulations...ResonantAcoustic Mixing can be used to homogeneously mix high viscosity materials..."	2021
	Powder Processing and Properties Characterization of Polyamide 11-Graphene anocomposites for Selective Laser Sintering	"...Nano-graphene platelets (NGPs) were added to polyamide 11 (PA11) powder in 1%, 3%, and 5% weight loading in an attempt to create electrostatic dissipative polymer nanocomposites (PNC) using SLS, a rapid manufacturing process. Powder-powder mixing techniques were explored as a potential replacement for twin-screw extrusion for dispersing nano-graphene platelets (NGPs) within a PA11 matrix. The ResodynTM ResonantAcoustic® Mixer [was evaluated for] powder-powder mixing techniques. After mixing, the powder samples were pressed into thin-films for characterization on TGA, SEM, four-probe conductivity, and Raman spectroscopy. Polymer nanocomposites of PA11 and nano-graphene platelets were mixed using powder mixing techniques. The Resodyn ResonantAcoustic® mixer [was] used with the addition of zirconia grinding media to aid in the breaking and exfoliation of graphene clusters..."	2020
	Development of a quantitative method to evaluate the printability of filaments for fused deposition modeling 3D printing	"...Lack of a conventional quantitative method for filament printability has been recognized as a critical barrier to fused deposition modeling (FDM) 3-D printing application. A small molecule drug, indomethacin, was used as a model compound to mix with polymers with various solubility. The indomethacin and polymer excipients with various ratios were mixed using a Resodyn LabRAM II ResonantAcoustic Mixer at 60g for one minute..."	2020

PUBLISHED ARTICLES
Energetics

Icon Legend

RAM testing, evaluation

Material/chemical properties

Powder/powder

Armament material

Liquid/powder

Materials processing

Materials/product quality

Pyrotechnics material

Explosives material

Propellant material

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	Primary Explosive Processing in the Resonant Acoustic Mixer	"[RAM's} ability to rapidly mix even highly viscous substances through application of acoustic energy while avoiding the use of traditional blades has provided substantial leaps forward in both safety and efficiency."	2021
	Safer Resonant Acoustic Mixing Methods for High-Volume Production of Pyrotechnics	"... , projected benefits of a production-scale RAM process may result in significant increases to overall throughput, labor cost reduction of 61-96%, and a reduction in acetone used for cleanup operations by over 99%."	2020
	Comparison of Propellant Processing by Cast-Cure and Resonant Acoustic Mixing	"For the propellant studied in this research, resonant acoustic mixing is a very promising, advanced processing technique that can be applied as an alternative to the conventional mechanical mixing of this high solid load propellant composition."	2020
	Resonant Acoustic® Mixing: Processing and Safety	"...technologies include additive manufacturing and Resonant Acoustic® Mixing (RAM), which are being demonstrated to reduce processing times, environmental impact and of course cost."	2020
	Burning Rate Characterization of Ammonium Perchlorate Pellets Containing Nano-Catalytic Additives	"Intimate contact between the AP (composite Ammonium Perchlorate) and nano-catalysts was ensured using a Resonant Acoustic Mixer (RAM)."	2020
	Processing Studies of Energetic Materials using Resonant Acoustic Mixing Technology	"...manufacturing methods within the energetics field can involve large amounts of solvents, long processing times, high waste output, high shear moving parts, and have single large batch limitations...manufacturing of energetic materials, propellants and pyrotechnics via RAM technology have highlighted many potential advantages."	2019

PUBLISHED ARTICLES
Energy Storage

Icon Legend

RAM testing, evaluation

Material/chemical properties

Powder/powder

Liquid/powder

Materials processing

Materials/product quality

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	Novel dry deposition of LiNbO3 or Li2ZrO3 on LiNi0. 6Co0. 2Mn0. 2O2 for high performance all-solid-state lithium batteries	"ResonantAcoustic® Mixing (RAM) technology is preferred embodiment modification of NCM."	2020
	Physical Property Analysis of Composite Electrodes with Different Active Material Sizes and Densities using 3D Structural Modeling	"...cast anode supports via resonant acoustic mixing technology for solid oxide fuel cells..."	2020
	Evaluation of RAM [Resonant Acoustic Mixing] Performance	"Resonant acoustic mixing can significantly reduce blending time, making it a good candidate for improving the efficiency of powder mixing processes."	2020
	Use of carbon coating on LiNi0. 8Co0.1Mn0.1O2 cathode material for enhanced performances of lithium-ion batteries	"...powders were mixed with different amounts (SPB 0.1 wt%, SPB 0.3 wt%, SPB 0.5 wt% and SPB 0.7 wt%) of super-P carbon black via resonant acoustic mixer (PharmaRAM™ I, Resodyn Acoustic Mixers Inc.) at the acceleration of high mix for 20 min. and then calcined at 300 °C for 3 h."	2020
	In Situ Metal Matrix Nanocomposites: Towards Understanding Formation Mechanisms and Microstructural Control	"A study (thesis) using ball mill and RAM mixing to observe interactions between particles and melt during solidification; determined these are highly complex processes."	2020
	Ultra-fast fabrication of tape-cast anode supports for solid oxide fuel cells via resonant acoustic mixing technology	"[RAM] Slurry optimization in 30 minutes vs. 4,320 minutes using ball mill"	2019
	Molten electrolyte dual-phase membranes for intermediate temperature fuel cells	Multiple application uses with varying materials are discussed.	2019
	Polyethylene/Graphene Nanoplatelet Nanocomposite-Based Insulating Materials for Effective Reduction of Space Charge Accumulation in High-Voltage ...	"...LDPE pellets and GNP powders were mixed in a dry state using a resonant acoustic mixer (RAM). GNP particles were uniformly embedded (or coated) on the LDPE pellet surfaces [and] aggregated GNP particles . . . were effectively pulverized by strong collisions between particles in the RAM mixing step..."	2019

PUBLISHED ARTICLES
Pharmaceuticals

Icon Legend

RAM testing, evaluation

Material/chemical properties

Powder/powder

Liquid/powder

Materials processing

Materials/product quality

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	Complete Cocrystal Formation during Resonant Acoustic Wet Granulation: Effect of Granulation Liquids	"Coprecipitated ASD powders (overhead mixing and resonant acoustic mixing) demonstrated superior tabletability and flow properties when compared to the spray drying powder. Careful choice of manufacturing process can be used to tune material properties of ASDs to make them more amenable for downstream operations like tableting."	2021
	A novel method for preparing stabilized amorphous solid dispersion drug formulations using acoustic fusion	"A diverse set of drug and polymer combinations have been effectively evaluated utilizing a newly developed method called acoustic fusion (which employs a LabRAM) to form amorphous solid dispersions (ASD) on the mg-scale, indicating that this approach is a general procedure that can be applied for ASD drug formulations."	2021
	Influence of guest and host particle sizes on dry coating effectiveness: When not to use high mixing intensity	"Examples from pharmaceutical applications include improving content uniformity of blends and powder flow... [using the] Resonant Acoustic Mixer (LabRAM) system..."	2020
	Impact of Method of Preparation of Amorphous Solid Dispersions on Mechanical Properties: Comparison of Coprecipitation and Spray Drying	"Coprecipitated ASD powders (overhead mixing and resonant acoustic mixing) demonstrated superior tabletability and flow properties when compared to the spray drying powder. Careful choice of manufacturing process can be used to tune material properties of ASDs to make them more amenable for downstream operations like tableting."	2019
	Ball-free mechanochemistry: in situ real-time monitoring of pharmaceutical co-crystal formation by resonant acoustic mixing	"The RAM technique...has been proposed as a method to perform mechanochemical processes under significantly more gentle conditions than those experienced during ball milling..."	2018

PUBLISHED ARTICLES
Powder Metals

Icon Legend

RAM testing, evaluation

Liquid/powder

Nanomaterial

Material/chemical properties

Materials processing

Powder/powder

Materials/product quality

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	Efficient production of a high-performance dispersion strengthened, multi-principal element alloy	"...additive manufacturing can be leveraged to produce dispersion strengthened (DS), multi-principal element alloys (MPEA) without the use of traditional mechanical alloying or chemical reactions. This new processing technique employed ResonantAcoustic® mixing to coat an equiatomic NiCoCr powder with nano-scale yttrium oxides. ...the acoustic mixing step successfully coated the NiCoCr powder. In addition, the powder maintains its spherical morphology as compared to the highly deformed platelet-like powder produced through MA making it more suitable for AM...."	2020
	NiZnCu-ferrite coated iron powder for soft magnetic composite applications	"...We use a Resodyn™ acoustic mixer to reduce milling time and allow for more uniform mixing, as compared to ball milling or blending. This technique is capable of coating micron-sized powder with nanopowder completely in less than 15 min as shown by Resodyn™ for Mg powder coated with MgO nanopowder. An acoustic mixer is adopted to adequately coat iron powder with ferrite particles in this work. We coat large iron powder with small NiZnCu-ferrite particles of (0.4 to 0.6 µm) using a small amount (0.5%) of lubricant addition to assist in coating and compaction. This coating method allows for adequate coating layers to be deposited in minimal amounts of time, in order to create faster manufacturing procedures and reduce costs related to processing..."	2018
	Low-Power Laser Ignition of Aluminum/Metal Oxide Nanothermites	"...A second method was subsequently used and does not involve the use of any solvent. A LabRAM mixer (Resodyn Acoustic Mixers, Inc.) was used, which can mix powders of different nature using low-frequency, high-intensity acoustic energy, creating a uniform shear field throughout the entire mixing container...The mixing procedure was done remotely. All resulting nanothermites were homogeneous..."	2014

PUBLISHED ARTICLES

Technical Ceramics

Icon Legend

- RAM testing, evaluation
- Material/chemical properties
- Powder/powder
- Ceramics
- Liquid/powder
- Materials processing
- Materials/product quality
- Nanomaterials

Icons	Publication Title (Live Links)*	RAM Application Summary	Year
	3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereolithography	"Ceramic inks for AM are of interest because of the advantages AM offers over traditional methods of ceramic forming...The 3YZ inks were made using solids loading in PEGDA ranging from 55 to 70 wt% (18–30 vol%, Table 2). The ink was mixed with spherical zirconia grinding beads (4 mm diameter) in an acoustic mixer (LabRAM II, Resodyn Acoustic Mixers, Butte, MT) for 3 h at 70 g-force to break up agglomerates and disperse the particles. The LabRAM II mixing time was determined by SEM images of the inks at different time points to ensure homogeneous dispersion."	2021
	Investigation of the impact of particle size on properties and applications of a ceramic slurry	"... To make the ceramic slurry, 3YZrO2 nanoparticles were mixed with polyethylene glycol diacrylate (PEGDA Mn 575, Sigma Aldrich) and zirconia grinding media and mixed for 3 hours in a Resodyn™ LabRAM II acoustic mixer..."	2019
	Consolidation of Aluminum Magnesium Boride (AlMgB14) by Pulsed Electric Current Sintering (PECS) Technique	"Aluminum magnesium boride (AlMgBn) is a ternary ceramic alloy which retains unique physical and mechanical properties... this study examines pulsed electric current sintering (PECS) technique with a focus on establishing baseline processing parameters required to produce dense compacts with uniform microstructure. Subsequently, elemental powders of Al-12%Mg-74.7%B (wt%) were homogeneously mixed in a Resodyn resonant acoustic mixer and sintered using a PECS apparatus, at a temperature and pressure of 1600°C and 72.58 MPa. Formation of AlMg0.5B14 and minor phases of MgAl 2O4 and Mg0.78Al0.75B14 during sintering was confirmed. These studies led to the discovery of the ceramic alloy aluminum magnesium boride..."	2014

PUBLISHED ARTICLES
Additive Manufacturing

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "resonant acoustic," "acoustic mixing," "Resodyn," AND/OR: "additive manufacturing," "3-D printing," "3D printing"

3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereolithography
AL Troksa, HV Eshelman, S Chandrasekaran…- Materials & Design, 2021- Elsevier
… Typically, ceramic inks for DIW are made from a highly viscous paste composed of ceramic … Ceramic AM can allow for creation of macroporous ceramics based on the geometry being … order to create micro- or nanoporous ceramics, extra post-processing steps are necessary. …

Related articles

Feasibility of Cryomilled 17-4 Stainless Steel Powder as Feedstock for Additive Manufacturing
F Kellogg, A Kudzal, C Mock, J Taggart-Scarff…- 2020- apps.dtic.mil
…Additive manufacturing (AM) is a catchall term for a suite of manufacturing processes that produces parts in a layer-by-layer method. Laser powder bed … The blending process was carried out with a Resodyn LabRAM II acoustic mixer operating for 1 h with 10 g's of acceleration…

Related articles

Efficient Production of a High-Performance Dispersion Strengthened, Multi-Principal Element Alloy
TM Smith, AC Thompson, TP Gabb, CL Bowman…- Scientific reports, 2020- nature.com
…Additive manufacturing currently facilitates new avenues for materials discovery that have not been fully explored. In this study we reveal how additive manufacturing can … A Resodyn LabRAM II resonant mixer was employed to coat the NiCoCr powder with one weight percent of…

Related articles

Additive manufacturing of ammonium perchlorate composite propellant with high solids loadings
MS McClain, IE Gunduz, SF Son- Proceedings of the Combustion Institute, 2019- Elsevier
…The effective solid propellant burning rate in a rocket depends on surface area andpropellant composition. Currently, the surface area geometry in a rocket is limited to whatcan be practically cast using molds, etc. Additive manufacturing (AM) could allow the…

Related articles

Additive manufacturing of carbon fiber reinforced silicon carbide solid rocket nozzles
MS McClain, IE Gunduz, SF Son- AIAA Scitech 2019 Forum, 2019- arc.aiaa.org
…low manufacturing costs, and/or reduced weight. However, manufacturing costs could be further reduced by using additive manufacturing (AM… 40 g batches were made in a resonant mixer (Resodyn) for three cycles of 3 minutes at 80 g's. The properties of the mixture did not vary…

Related articles

PUBLISHED ARTICLES
Advanced Materials

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "resonant acoustic" "acoustic mixing" AND/OR: "Resodyn," "nanomaterials," "ceramics," "polymers," and "advanced mate-

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Resonant Acoustic Mixing Method to Produce Lipid-Based Liquid-Crystal Nanoparticles
D Yalcin, S Rajesh, J White, SC Howard…- The Journal of …, 2021- ACS Publications
… Chem. C 2021, XXXX, XXX, XXX-XXX. ADVERTISEMENT. RETURN TO ARTICLES ASAPPREVC: Physical Properti...C: Physical Properties of Materials and Interfaces NEXT. Journal Logo. Resonant Acoustic Mixing Method to Produce Lipid-Based Liquid-Crystal Nanoparticles …

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3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereo lithography
AL Troksa, HV Eshelman, S Chandrasekaran…- Materials & Design, 2021- Elsevier
… Common methods for making porous ceramics make use of sacrificial pore formers, direct foaming …beads (4 mm diameter) in an acoustic mixer (LabRAM II, Resodyn Acoustic Mixers … Once the initiator was added, the ceramic ink was ready for subsequent characterization and …

Related articles

The Effects of Resonant Acoustic Mixing on the Microstructure of UHPC
A Vandenberg, K Wille- International Interactive Symposium …, 2019- iastatedigitalpress.com
… High-intensive mixers that provide high energy input to the system and have power consumption instrumental capabilities have advanced the field of … (b) Resodyn LabRAM … "Monitoring of Concrete Homogenisation with the Power Consumption Curve." Materials and Structures …

Related articles

Investigation of the impact of particle size on properties and applications of a ceramic slurry
HV Eshelman- 2019- osti.gov … Aldrich) and zirconia grinding media and mixed for 3 hours in a Resodyn™ LabRAM II … Thermal initiator and photoinitiator (if needed) were added and the slurry was mixed in a … https://www.tosoh.com/our-products/advanced-materials/zirconia-powders (accessed Apr 15, 2019).

Related articles

Investigating High Energy Mixing in Cement-based Materials
A Vandenberg- 2018- opencommons.uconn.edu
… and carbon nanofibers (CNF), with and without polyvinyl phenol polymer-wrapping … The heart of the project is to learn many material characterization skills and apply them to different questions relating to cementitious materials. Rheology, electron microscopy, dynamic light …

Related articles

PUBLISHED ARTICLES
Advanced Polymers

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "resonant acoustic," "acoustic mixing," "materials," AND/OR: "Resodyn," "polymers," "polymeric nanomaterials," "advanced polymers."

A novel method for preparing stabilized amorphous solid dispersion drug formulations using acoustic fusion
Z Guo, C Boyce, T Rhodes, L Liu, GM Salituro…- International Journal of …, 2021- Elsevier
… benchtop resonant acoustic mixer by Resodyn. The block can hold up to 24 different 4 mL glass vials… one polymer and heating the mixture to a temperature higher than the glass transition or melting point temperatures of at least one of the polymers or the API, the crystalline API and polymers…

Related articles

Powder Processing and Properties Characterization of Polyamide 11-Graphene anocomposites for Selective Laser Sintering
DZ Chen, S Lao, JH Koo…- Proc. 2010 solid …, 2010- utw10945.utweb.utexas.edu
… extend the paradigm of traditional composite materials by introducing fillers in the nano-scale to ceramic, metal, or polymer matrices. … Materials Preparation and Processing The Resodyn ResonantAcoustic® mixer (RAM) was the first method used to mix the PA11 and nano-graphene…

Related articles

Development of a quantitative method to evaluate the printability of filaments for fused deposition modeling 3D printing
P Xu, J Li, A Meda, F Osei-Yeboah, ML Peterson…- International Journal of …, 2020- Elsevier
… Indomethacin and polymer excipients with various ratios were mixed using a Resodyn LabRAM II ResonantAcoustic® mixer at 60G for 1 min. The physical mixtures were then fed into the extruder at 3–5 g/min (depending on the torque) using a magnetic feeder (Model: FTOC, Syntron) and …

Related articles

Milling of Energetic Crystals with the LabRAM
LN Kotter, LJ Groven- Propellants, Explosives, Pyrotechnics, 2019- Wiley Online Library
… Over the last decade, the Resodyn LabRAM acoustic mixer has been widely used for mixing of powders and for the … polymer, anywhere from 5 % to 15 % ethylene is doped within the polymer. This doping of the PP chains by ethylene links randomizes the structure of the polymer …

Related articles

3D printing of polymer-bonded magnets from highly concentrated, plate-like particle suspensions
A Shen, X Peng, CP Bailey, S Dardona, AWK Ma- Materials & Design, 2019- Elsevier
… Recently, 3D printing of polymer-bonded magnets has gained research interest over … In this method, ferromagnetic particles (NdFeB) are first dispersed in a UV curable polymer binder ... For compounding the powder with the UV binder, a Resodyn LabRAM II acoustic mixer was …

Related articles

PUBLISHED ARTICLES
Energetic Materials

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "Resonant Acoustic Mixing," "materials," AND/OR "energetic material," "pyrotechnics," "explosives," "acoustic mixer," and "Resodyn."

Primary Explosive Processing in the Resonant Acoustic Mixer
E Beckel, K Oyler, N Mehta, N Khatri…- Propellants …, 2021- Wiley Online Library
… To date, RAM has been applied by the energetics community to a variety of secondary explosive …material has been qualified by the US Navy and the US Army Energetic Materials Qualification … A LabRAM unit was donated to DEVCOM AC by Resodyn Acoustic Mixers for these trials …

Safer Resonant Acoustic Mixing Methods for High-Volume Production of Pyrotechnics
E Miklaszewski, MCM Yamamoto, MJT Dunham…- 2020- serdp-estcp.org
Magnesium (Mg)/Sodium Nitrate (NaNO3)/Epoxy formulations and their derivatives are a high volume pyrotechnic that is utilized in illumination and colored flare applications for the Army, Navy and Air Force (Figure 1)[1]. Such illuminant compositions are typically …

Related articles

Comparison of Propellant Processing by Cast-Cure and Resonant Acoustic Mixing
M Zebregs, AEHJ Mayer…- … , Pyrotechnics, 2020- Wiley Online Library
In this comparative study, a solid composite, AN/HTPB-based propellant was prepared by conventional processing in a mechanical mixer and by applying an advanced processing technique relying on resonant acoustic mixing (RAM). After curing of the propellants, cross …

Related articles

Resonant Acoustic® Mixing: Processing and Safety
MR Andrews, C Collet, A Wolff…- Propellants, Explosives …, 2020- Wiley Online Library
… Standard practice for energetics processing is to remotely operate the equipment so that in … Several survey respondents had to separate loading of energetic materials in a suitable facility … Within the time frame of the survey, Resodyn released a hazardous areas approved version …

Related articles

Burning Rate Characterization of Ammonium Perchlorate Pellets Containing Nano-Catalytic Additives
FA Rodriguez, JC Thomas, D Teitge…- AIAA Scitech 2020 …, 2020- arc.aiaa.org
… A RAM utilizes resonant … acoustic waves that violently gyrate the powder to induce mixing … DL, Seal, S., Petersen, EL, "Comparison of Commercially Available and Synthesized Titania Nano-Additives in Composite HTPB/AP Propellant," Propellants, Explosives, Pyrotechnics, Vol …

Related article

Processing Studies of Energetic Materials using Resonant Acoustic Mixing Technology
RJ Davey, JM Wilgeroth, AO Burn- Propellants, Explosives …, 2019- imemg.org
… of energetics. Land UK has been investigating the ability of RAM to process a range of different energetic materials, including PBXs and Low Vulnerability Ammunition (LOVA) propellant formulations. These studies have involved processing energetic materials using Resodyn's …

Related article

PUBLISHED ARTICLES
Energy Storage Materials

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "Resonant Acoustic Mixing," "materials," AND/OR: "battery," "batteries," "RAM," "Resodyn," "energy storage."

NiCo2S4 Bi-metal Sulfide Coating on LiNi0.6Co0.2Mn0.2O2 Cathode for High-Performance Solid-State Li Batteries
YJ Kim, R Rajagopal, S Kang, KS Ryu- ACS omega, 2021- ACS Publications
NiCo2S4 nanoparticles (NPs) were dry coated on LiNi0. 6Co0. 2Mn0. 2O2 (NCM622)cathode using a resonant acoustic coating technique to produce all-solid-state lithiumbatteries.

Novel dry deposition of LiNbO3 or Li2ZrO3 on LiNi0. 6Co0. 2Mn0. 2O2 for high performance all-solid-state lithium batteries
[[TTE: Resonant-Acoustic technique was adapted for modification of NCM.]] YJ Kim, R Rajagopal, S Kang, KS Ryu- Chemical Engineering Journal, 2020- Elsevier
… recent years. In addition, Li-conducting polymer and solid electrolyte as well as electrodes have been investigated since the 1960s to develop and commercialize the Li-S batteries, Li-ion battery, and ASSLBs [9], [10]. In recent …

Related articles

Physical Property Analysis of Composite Electrodes with Different Active Material Sizes and Densities using 3D Structural Modeling
S Yang, J Park, S Byun, N Kim…- Journal of the Korean …, 2020- koreascience.or.kr
Composite electrodes for rechargeable batteries generally consist of active material, electric conductor, and polymeric binder. And their composition and distribution within the composite electrode determine the electrochemical activity in the electrochemical systems. However, it is not easy to quantify the physical properties of composite electrodes themselves using conventional experimental analysis tools. …

Related articles

Use of carbon coating on LiNi 0.8 Co 0.1 Mn 0.1 O 2 cathode material for enhanced performances of LIBs
SJ Sim, SH Lee, BS Jin, HS Kim- Scientific RepoRtS, 2020- nature.com
… The demand of lithium-ion batteries (LIBs) has been intensively increasing with growing large-scale devices such as … 0.3 wt%, SPB 0.5 wt% and SPB 0.7 wt%) of super-P carbon black via resonant acoustic mixer (PharmaRAM™ I, Resodyn Acoustic Mixers Inc.) at …

Related articles

In Situ Metal Matrix Nanocomposites: Understanding Formation Mechanisms and Microstructural Control
C Reese- 2020- deepblue.lib.umich.edu
Lightweight materials are critical to meet the ever-increasing demands for improved fuel economy in the automotive, aerospace and defense industries. Consequently, aluminum alloys have been employed extensively in these industries for structural applications owing to their high strength-to-weight ratio. However, Al alloys suffer from several shortcomings, such as poor thermal stability of mechanical properties, …

Related articles

PUBLISHED ARTICLES
Pharmaceutical Materials

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): “Resonant Acoustic Mixing,” “materials,” AND/OR: “pharmaceutical,” “RAM,” “compound,” “API,” “formulation.”

Complete Cocrystal Formation during Resonant Acoustic Wet Granulation: Effect of Granulation Liquids
R Tanaka, S Osotprasit, J Peerapattana, K Ashizawa…- Pharmaceutics, 2021- mdpi.com
….the current study was to achieve simultaneous completion of THPCIT cocrystallization and granulation during the resonant wet acoustic granulation (RAG … Our project team hypothesized that the RAG system would accomplish a powerful mixing of materials that would easily …

Related articles

A novel method for preparing stabilized amorphous solid dispersion drug formulations using acoustic fusion
Z Guo, C Boyce, T Rhodes, L Liu, GM Salituro…- International Journal of …, 2021- Elsevier
… As a general procedure, an acoustic heating block attached to a Labram resonant acoustic mixer was preheated … The vial was capped and then placed in the acoustic fusion heating block and lamped … While the heating/mixing time varied from 15 to 60 min, most drug samples …

Related articles

Influence of guest and host particle sizes on dry coating effectiveness: When not to use high mixing intensity
K Zheng, K Kunnath, Z Ling, L Chen, RN Davé- Powder Technology, 2020- Elsevier
… Examples from pharmaceutical applications include improving content uniformity of blends and powder flow, engineered … In what follows, the particle material properties, effects of particle sizes, and mixing intensity are … (9). The Resonant Acoustic® Mixer (LabRAM) system …

Related articles

Impact of method of preparation of amorphous solid dispersions on mechanical properties: Comparison of coprecipitation and spray drying
HH Hou, A Rajesh, KM Pandya, JW Lubach…- … of pharmaceutical …, 2019- Elsevier
… Precipitation by resonant acoustic mixing (RAM): GDC-0810 and HPMC-as MF (1:1 weight ratio) were dissolved in 30 … Figure 1. Experimental setup used to perform precipitation using acoustic mixing … for 1 H and 125.77 MHz for 13 C, along with a double resonance magic-angle …

Related articles

Ball-free mechanochemistry: in situ real-time monitoring of pharmaceutical co-crystal formation by resonant acoustic mixing
AAL Michalchuk, KS Hope, SR Kennedy…- Chemical …, 2018- pubs.rsc.org
… 1 Schematic representation of the resonant acoustic mixer (left), and photograph of experimental setup at … of approximately 61 Hz that corresponds to the mechanical resonance frequency of … Provided thorough mixing can be achieved, and new reactive interfaces can be formed …

Related articles

PUBLISHED ARTICLES
Powder Metal Materials

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "powder metals," "materials," AND/OR: "Resonant acoustic," "acoustic mixing," "Resodyn."

Efficient production of high-performance dispersion strengthened, multi-principal element alloy
TM Smith, AC Thompson, TP Gabb, CL Bowman…- Scientific reports, 2020- nature.com
Additive manufacturing currently facilitates new avenues for materials discovery that have not been fully explored. In this study we reveal how additive manufacturing can be leveraged to produce dispersion strengthened (DS), multi-principal element alloys (MPEA) without the use of traditional mechanical alloying or chemical reactions. This new processing technique employed resonant acoustic mixing to coat an equiatomic NiCoCr powder with nano-scale yttrium oxides. Then, through laser powder bed fusion (L-PBF), the …

Related articles

Simple, scalable mechanosynthesis of metal–organic frameworks using liquid-assisted resonant acoustic mixing (LA-RAM)
HM Titi, JL Do, AJ Howarth, K Nagapudi, T Friščić- Chemical science, 2020- pubs.rsc.org
We present a rapid and readily scalable methodology for the mechanosynthesis of diverse metal–organic frameworks (MOFs) in the absence of milling media typically required for other types of mechanochemical syntheses. We demonstrate the use of liquid-assisted resonant acoustic mixing (LA-RAM) methodology for the synthesis of three-and two-dimensional MOFs based on Zn (II), Co (II) and Cu (II), including a mixed ligand system.
Importantly, the LA-RAM approach also allowed the synthesis of the ZIF-L framework that …

Related articles

NiZnCu-ferrite coated iron powder for soft magnetic composite applications
KJ Sunday, ML Taheri- Journal of Magnetism and Magnetic Materials, 2018- Elsevier
… We use a Resodyn™ acoustic mixer to reduce milling time and allow for more uniform mixing, as compared to ball milling or blending. … of coating micron-sized powder with nanopowder completely in less than 15 min as shown by Resodyn™ for Mg powder coated with MgO …

Related articles

Low-power laser ignition of aluminum/metal oxide nanothermites
CF Petre, D Chamberland, T Ringuette…- … Journal of Energetic …, 2014- dl.begellhouse.com
… In addition to the above method, the three nanothermites were also produced using a Resodyn LabRAM mixer. A paraffin-coated spher… of aluminum and metal oxide nanopowders, unlike conventional thermites, which are composed of micrometer-sized powders. The rate of …

Related articles

Impact Ignition and Combustion Behavior of Amorphous Metal-Based Reactive Composites
L Groven, B Mason, S Son- Bulletin of the American Physical Society, 2013- APS
… that metal-based reactive powder … metals, such as Zr and Ti based amorphous alloys in combination with carbon, boron, and aluminum. Based on the calculations and material availability material combinations were chosen. Initial materials were either mixed via a Resodyn …pellants. Typically, metal powder used in making metallized propellants, is in the form of micron-sized particles. The liquid propellant is gelled with an additive...

Related articles

PUBLISHED ARTICLES

Technical Ceramics

Partial (edited) selection of searched technical articles using the following search terms (articles are live links): "resonant acoustic" "acoustic mixing" AND/OR: "Resodyn," "technical ceramics"

3D-printed nanoporous ceramics: Tunable feedstock for direct ink write and projection microstereolithography

AL Troksa, HV Eshelman, S Chandrasekaran…- Materials & Design, 2021- Elsevier

… Typically, ceramic inks for DIW are made from a highly viscous paste composed of ceramic… Ceramic AM can allow for creation of macroporous ceramics based on the geometry being … order to create micro- or nanoporous ceramics, extra post-processing steps are necessary…

Related articles

Investigation of the impact of particle size on properties and applications of a ceramic slurry

HV Eshelman- 2019- osti.gov

… Ceramic materials have a wide array of applications due to their desirable properties such as… ceramic slurry, 3YZrO2 nanoparticles were mixed with polyethylene glycol diacrylate (PEGDA Mn 575, Sigma Aldrich) and zirconia grinding media and mixed for 3 hours in a Resodyn…

Related articles

Consolidation of Aluminum Magnesium Boride (AlMgB14) by Pulsed Electric Current Sintering (PECS) Technique

N Kedir, G Gilde, K Cho- Advances in Ceramic Armor IX, 2013- Wiley Online Library

Aluminum magnesium boride (AlMgBn) is a ternary ceramic alloy which retains … were homogeneously mixed in a resonant acoustic mixer and sintered using a PECS apparatus...Formation of AlMg0.5B14 and minor phases of MgAl 2O4 and Mg0.78Al0.75B14 during sintering was confirmed by X-ray diffraction (XRD) and energy dispersive X-ray spectroscopy (EDS) analysis.

Related articles

Fabrication of high density pellets of ZrO2 via particle processing

TT Meek, J Yarringtonb- Journal of Ceramic Processing Research, 2013

...A low temperature-processing route that enables near net shapes in almost theoretical density is highly desirable. In order to carry out low-temperature processing, it is necessary to design oxide blends with ontrolled particle sizes. A compact made of the right mix of particles can be pressed at room temperature to near theoretical density. Powders have been blended to form multimodal distributions...

Related articles

Chemically bonded phosphate ceramics composites reinforced with graphite nanoplatelets

HA Colorado, C Hiel, HT Hahn- Composites Part A: Applied Science and …, 2011- Elsevier

… Two different mixing techniques were used, Thinky and Resonant Acoustic Mixing (RAM). Results showed both techniques are effective to … Ceramics (CBPCs) materials as a potential substitution for ultra high strength cements and as an alternative ceramic based material for …

Related articles

RELEVANT PATENTS
Additive Manufacturing

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Chemical-free fabrication of graphene reinforced polymer matrix composites

Abstract

A simple, rapid, scalable, environmentally friendly method of directly producing graphene reinforced polymer matrix composites from graphitic materials: (a) a plurality of graphitic materials in a collision chamber of an energy collision device. Mixing a plurality of particles of the solid polymer support material to form a mixture; (b) exfoliating the graphene sheet from the graphite material and transferring the graphene sheet to the surface of the solid polymer support material particles Operating the energy collision device with a frequency and intensity for a time sufficient to form graphene coated polymer particles or graphene embedded polymer particles inside the collision chamber; (c) graphene coated polymer particles or graphene-reinforced polymer matrix composite from embedded polymer particles Method comprising the steps of forming is provided. Also provided are materials of graphene coated polymer particles or graphene embedded polymer particles produced by this method.

Three-dimensional printing

Abstract

An example of a build material composition for three-dimensional (3D) printing includes a polyamide material and an antioxidant. The antioxidant consists of an aromatic multihydrazide; or an aromatic sulfonomonohydrazide; or a hydrazide having formula (I) disclosed herein, wherein: R is null, a C1 to C12 unbranched alkyl, a C3 to C8 branched alkyl, a C2 to C8 unbranched alkylene, a C4 to C8 branched alkylene, an alicyclic compound, a polyethylene glycol, or a combination thereof; A is C=O, O=S=O, P=O, or C=S; and n is an integer ranging from 1 to 4; or formula (II) disclosed herein wherein A is C=O, O=S=O, P=O, or C=S.

Method for resonant-vibratory mixing

Abstract

A method for mixing fluids and/or solids in a manner that can be varied from maintaining the integrity of fragile molecular and biological materials in the mixing vessel to homogenizing heavy aggregate material by supplying large amounts of energy. Variation in the manner of mixing is accomplished using an electronic controller to generate signals to control the frequency and amplitude of the motor(s), which drive an unbalanced shaft assembly to produce a linear vibratory motion. The motor may be a stepper motor, a linear motor or a DC continuous motor. By placing a sensor on the mixing vessel platform to provide feedback control of the mixing motor, the characteristics of agitation in the fluid or solid can be adjusted to optimize the degree of mixing and produce a high quality mixant.

RELEVANT PATENTS
Advanced Materials

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Integral 3D graphene-carbon hybrid foam

Provided is an integral 3D graphene-carbon hybrid foam composed of multiple pores and pore walls, wherein the pore walls contain single-layer or few-layer graphene sheets chemically bonded by a carbon material having a carbon material-to-graphene weight ratio from 1/100 to 1/2, wherein the few-layer graphene sheets have 2-10 layers of stacked graphene planes having an inter-plane spacing d002 from 0.3354 nm to 0.40 nm and the graphene sheets contain a pristine graphene material having essentially zero % of non-carbon elements, or a non-pristine graphene material having 0.01% to 25% by weight of non-carbon elements wherein said non-pristine graphene is selected from graphene oxide, reduced graphene oxide, graphene fluoride, graphene chloride, graphene bromide, graphene iodide, hydrogenated graphene, nitrogenated graphene, doped graphene, chemically functionalized graphene, or a combination thereof. Also provided are a process for producing the hybrid form, products containing the hybrid foam, and its applications.

Supercapacitor with integrated 3D graphene-carbon hybrid foam-based electrode

A supercapacitor having an anode, a cathode, a porous separator / electrolyte, wherein at least one electrode comprises an integral 3D graphene-carbon hybrid foam composed of a plurality of pores and pore walls, Includes a single-layer or several-layer graphene sheet chemically bonded by a carbon material having a carbon material to graphene weight ratio of 1/100 to 1/2, and the several-layer graphene sheet has an interplanar spacing of 0.3354 nm to 0.40 nm a pure graphene material having 2 to 10 layers of graphene surfaces with d002, wherein the graphene sheet has substantially 0% non-carbon elements, or 0.01 wt% to 25 wt% non-carbon elements An impure graphene material, wherein the impure graphene includes graphene oxide, reduced graphene oxide, graphene fluoride, salt Graphene bromide graphene iodide graphene, hydrogenated graphene, nitrogen graphene, doped graphene, are selected from the chemical functionalization graphene, or a combination thereof, the super capacitor is provided.

Chemical-free production of graphene-wrapped electrode active material particles for battery applications

Provided is a simple, fast, scalable, and environmentally benign method of producing graphene-embraced or encapsulated particles of a battery electrode active material directly from a graphitic material, the method comprising: a) mixing graphitic material particles, multiple particles of an electrode active material, and non-polymeric particles of milling media to form a mixture in an impacting chamber, wherein the graphitic material has never been intercalated, oxidized, or exfoliated and the chamber contains therein no previously produced graphene sheets; b) operating the energy impacting apparatus with a frequency and an intensity for a length of time sufficient for peeling off graphene sheets from the graphitic material and transferring graphene sheets to surfaces of electrode active material particles to produce graphene-embraced active material particles; and c) recovering the graphene-embraced particles from the impacting chamber. Also provided is a mass of the graphene-embraced particles, electrode containing such particles, and battery containing this electrode.

Thermoelectric polymer composite, method of making and use of same

A thermoelectric composite includes a plurality of particles comprising a crosslinked polymer having a heat deflection temperature greater than or equal to 200° F. and a segregated network comprising a first filler material which is disposed between the particles to produce a thermoelectric response in response to application of a voltage difference or temperature difference across the thermoelectric composite. The first filler material includes a carbon material, a metal, a metal disposed on a carbon material, or a combination thereof. A process for preparing a thermoelectric article includes combining a first filler material and a plurality of particles comprising a polymer to form a composition and molding the composition to form a thermoelectric article, wherein the thermoelectric article is configured to produce a thermoelectric response in response to application of a voltage difference or temperature difference across the article.

RELEVANT PATENTS
Advanced Polymers

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Chemical-free production of graphene-reinforced polymer matrix composites

Abstract

Provided is a simple, fast, scalable, and environmentally benign method of producing a graphene-reinforced polymer matrix composite directly from a graphitic material, the method comprising: (a) mixing multiple particles of a graphitic material and multiple particles of a solid polymer carrier material to form a mixture in an impacting chamber of an energy impacting apparatus; (b) operating the energy impacting apparatus with a frequency and an intensity for a length of time sufficient for peeling off graphene sheets from the graphitic material and transferring the graphene sheets to surfaces of solid polymer carrier material particles to produce graphene-coated or graphene-embedded polymer particles inside the impacting chamber; and (c) forming graphene-coated or graphene-embedded polymer particles into the graphene-reinforced polymer matrix composite. Also provided is a mass of the graphene-coated or graphene-embedded polymer particles produced by this method.

Solvent-free emulsion process using acoustic mixing

Abstract

A process for making toner particles is provided. In embodiments, a suitable process includes melt mixing a resin in the absence of an organic solvent, optionally adding a surfactant to the resin, adding to the resin at least one colorant and other optional toner additives, adding to the resin a basic agent and water to form a mixture, and subjecting the mixture to acoustic mixing at a suitable frequency to form to form an emulsion. A phase inversion may then be performed to create a phase inversed emulsion including a disperse phase comprising molten resin and the optional ingredients of the toner composition, at which time toner-sized droplets may be solidified from the disperse phase into toner particles, which can be recovered for use.

Method of making polymer matrix composites

Abstract

Method of making a polymer matrix composite comprising a porous polymeric network structure; and a plurality of particles distributed within the polymeric network structure, the method comprising: combining a thermoplastic polymer, a solvent that the thermoplastic polymer is soluble in, and a plurality of particles to provide a slurry; forming the slurry in to an article; heating the article in an environment to retain at least 90 percent by weight of the solvent, based on the weight of the solvent in the slurry, and inducing phase separation of the thermoplastic polymer from the solvent to provide the polymer matrix composite.

Improvements in or relating to energetic materials

Abstract

Energetic materials comprising active components, a polymer binder matrix and a tackifying resin are useful as propellants, fuels, pyrotechnic materials and explosives; the tackifying resin improves the adhesion and dispersion of the active components throughout the binder resin.

High molecular weight zwitterion-containing polymers

Abstract

The present invention provides multi-armed high MW polymers containing hydrophilic groups and one or more functional agents, and methods of preparing such polymers.

RELEVANT PATENTS
Energetic Materials

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Improvements in or relating to energetic materials
WO EP US KR GB US20180305270A1 Kenneth Lewtas Lewtas Science & Technologies Ltd
Priority 2015-10-12 • Filed 2016-10-12 • Published 2018-10-25
Energetic materials comprising active components, a polymer binder matrix and a tackifying resin are useful as propellants, fuels, pyrotechnic materials and explosives; the tackifying resin improves the adhesion and dispersion of the active components throughout the binder resin.

Propellant and Explosives Production Method by Use of Resonant Acoustic Mix …
WO EP US US20100294113A1 Michael D. McPherson Mcpherson Michael D
Priority 2007-10-30 • Filed 2008-10-15 • Published 2010-11-25
A method to charge a container with an energetic mix is disclosed. This method includes the following steps: (a) adding a plurality of particulate energetic mix constituents and a binder to the container; and (b) mixing the plurality of energetic mix constituents utilizing a non-contact mixer to …

Resonant acoustic mixing (ram) of an explosive composition (2)
WO EP US AU CA US20200062669A1 Andy Oden Burn Bae Systems Plc
Priority 2017-04-03 • Filed 2018-03-28 • Published 2020-02-27
The invention relates to a cast explosive composition, particularly to a pre-cure castable explosive composition comprising an explosive material, a polymerisable binder, a microencapsulated cross linking reagent, said microencapsulated cross linking reagent, comprising a cross linking agent …

Resonant acoustic mixing (ram) of an explosive composition (1)
EP EP3385246A1 designation of the inventor has not yet been filed The BAE SYSTEMS plc
Priority 2017-04-03 • Filed 2017-04-03 • Published 2018-10-10
The invention relates to a cast explosive composition, particularly to a pre-cure castable explosive composition comprising an explosive material, a polymerisable binder, a microencapsulated cross linking reagent, said microencapsulated cross linking reagent, comprising a cross linking agent …

Process for the preparation of composite pyrotechnic products
FR FR3090629A1 Marie COQUILLAT Arianegroup Sas
Priority 2018-12-20 • Filed 2018-12-20 • Published 2020-06-26
The present invention relates to a process for the preparation of a composite pyrotechnic product containing organic energetic charges of the nitramine type in a plasticized binder, this process comprising: a) the preparation of a crosslinked polymer of the polymer type with hydroxy terminal …

A kind of solid-propellant pulps without slurry mixing preparation method and …
CN CN108043305A Lu Zhimeng Wen Changyan Zuo Juntao Zeng Qinglin Wang Qingsong Sun Tao Lu Yan
Priority 2018-01-03 • Filed 2018-01-03 • Published 2018-05-18
This application provides a kind of solid-propellant pulps without paddle mixing preparation method and system, including material to be mixed is put into mixing vessel by preset quality mixing vessel is fastened with acoustic resonance mixers mixing vessel and material to be mixed are heated ...

RELEVANT PATENTS
Energy Storage Materials

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Method of manufacturing electrode, electrode manufactured by the same, membrane …
WO EP US CN JP JP2020145210A
Priority 2016-12-28 • Filed 2020-06-08 • Published 2020-09-10
To provide an electrode with improved various performances by increasing a utilization rate of a catalyst and an ionomer and a carbon structure having improved dispersion stability of the carbon structure and the ionomer.SOLUTION: Provided are an electrode, including a catalyst 2 and an ionomer 3, …

Method for manufacturing ionomer coated carbon structure and ionomer coated …
KR KR102175008B1
Priority 2017-01-02 • Filed 2017-01-02 • Granted 2020-11-05 • Published 2020-11-05
The present invention relates to a method of manufacturing a carbon structure coated with an ionomer, a carbon structure coated with an ionomer, a carbon structure coated with the ionomer, a carbon structure assembly coated with an ionomer, and the film-ionomer A fuel cell comprising a coated …

Hydrophobic coatings comprising hybrid microspheres with nano/micro roughness
WO EP CN KR TW TW202003718A
Priority 2018-05-31 • Filed 2019-05-31 • Published 2020-01-16
Described herein are coatings based on a hydrophobic polymer matrix and hydrophobic nanoparticles that provide a damage tolerant hydrophobic, superhydrophobic, and/or snowphobic capability, wherein the nanoparticles can comprise modified and phyllosilicate nanoclays. The micro and nano roughness …

Graphene-carbon hybrid foam-protected anode active material coating for lithium …
WO WO2020154258A1 Bor Z. Jang Global Graphene Group, Inc.
Priority 2019-01-21 • Filed 2020-01-21 • Published 2020-07-30
Provided is a porous anode material structure for a lithium-ion battery (and method of manufacturing same), the structure comprising (A) an integral 3D graphene-carbon hybrid foam comprising multiple pores, having a pore volume Vp, and pore walls; and (B) coating of an anode active material, …

Method of producing graphene-carbon hybrid foam-protected anode active material …
US US20200235393A1 Bor Z. Jang Nanotek Instruments, Inc.
Priority 2019-01-21 • Filed 2019-01-21 • Published 2020-07-23
Provided is method of producing a porous anode material structure for a lithium-ion battery, the method comprising (A) providing an integral 3D graphene-carbon hybrid foam comprising multiple pores, having a pore volume Vp, and pore walls; and (B) impregnating or infiltrating the pores with a …

Alkali metal battery with electrodes based on integrated 3D graphene-carbon- …
WO US CN JP KR JP2019521476A
Nanotek Instruments Priority 2016-06-07 • Filed 2017-06-01 • Published 2019-07-25
The anode includes an integrated 3D graphene-carbon hybrid foam composed of a plurality of pores, pore walls, and a lithium adsorbing metal present in the pores, the metals being Au, Ag, Mg, Zn, Ti, Na , K, Al, Fe, Mn, Co, Ni, Sn, V, Cr, or alloys thereof, in an amount of 0.1% to 50% of the total …

RELEVANT PATENTS
Pharmaceuticals

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Process for making agglomerates using acoustic mixing technology
WO EP US JP AU CA AU2013345062B2 Sai Prasanth Chamarthy Merck Sharp & Dohme Corp.
Priority 2012-11-16 • Filed 2013-11-12 • Granted 2018-02-08 • Published 2018-02-08
Described herein is a process for preparing agglomerates comprising: (i) providing a dry powder mixture of one, two, or three active pharmaceutical agent(s), and at least one excipient; and (ii) applying acoustic energy to said dry powder mixture to form agglomerates.

Method to Produce and Scale-Up Cocrystals and Salts Via Resonant Acoustic …
EP US US20150080567A1 Jerry Salan Nalas Engineering Services Inc.
Priority 2013-09-04 • Filed 2014-08-28 • Published 2015-03-19
A method to produce and manufacture cocrystals and salts is disclosed wherein crystalline solids and other components were combined in the desired proportions into a mixing chamber and mixed at high intensity to afford a cocrystalline product. No grinding media were required. The mixing system …

Method and apparatus
WO EP US CN JP KR AU CA GB HK IL IN MX NZ RU SG MX2014011795A Matthew Green Vectura Ltd
Priority 2012-03-30 • Filed 2013-03-28 • Published 2015-01-12
A method is disclosed for making a pharmaceutical composition for pulmonary administration, the method comprising a step in which an inhalable pharmaceutically active material is acoustically blended in a resonant acoustic blender. The invention also relates to compositions for inhalation prepared …

Media milling process for the manufacture of active pharmaceutical ingredients …
WO EP US US20160317391A1 Balaji Bharatwaj Merck Sharp & Dohme Corp.
Priority 2013-12-17 • Filed 2014-12-12 • Published 2016-11-03
The invention disclosed herein is a novel media milling process performed in an atmosphere of propellants(s) utilizing a resonant acoustic mixing (RAM) device. The process is utilized to reduce the particle size of API (optionally including excipients) to a respirable size range while ensuring the …

Mechanical system that continuously processes a combination of materials
US US9808778B2 Lawrence C. Farrar Resodyn Corporation
Priority 2012-05-31 • Filed 2013-08-13 • Granted 2017-11-07 • Published 2017-11-07
The present application is directed towards systems and methods for continuously reacting a combination of materials by use of an acoustic agitator and a continuous process vessel. The system can react, fluidize, mix, coat, dry, combine or segregate materials. The continuous processing system can …

Method for producing dispersion and inkjet recording method
WO JP WO2018061989A1
Priority 2016-09-30 • Filed 2017-09-21 • Published 2018-04-05
Provided are: a method for producing a dispersion, comprising a step for obtaining a mixture by filling at least one type of particles selected from inorganic particles and organic particles, a dispersing agent, and a dispersion medium in a sealed container and mixing the substances filled in the …

RELEVANT PATENTS
Powder Metals

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Glass-metal composites and method of manufacture
WO EP US CN WO2014197094A2 Carsten Weinhold Schott Corporation
Priority 2013-03-15 • Filed 2014-03-14 • Published 2014-12-11
The shaped composites of the present disclosure have metal powder bonded with glass powder. This feature provides the advantages of metal, metal powder, or glass composite materials, without suffering from the disadvantages. The composite is prepared with simple sintering methods, and can easily …

Method of making a cemented carbide or cermet powder by using a resonant …
EP ES EP2584057B1 Carl-Johan Maderud Sandvik Intellectual Property AB
Priority 2011-10-17 • Filed 2011-10-17 • Granted 2016-08-03 • Published 2016-08-03
A method of making a cemented carbide or cermet agglomerated powder without milling, where the powder constituents are subjected to a non-milling mixing operation, comprising the steps of: forming a slurry of one or more powders forming hard constituents, metal binder powders and a mixing liquid, …

Cemented carbide containing tungsten carbide and finegrained iron alloy binder
US US20180142331A1 John J. Pittari, III U.S. Army Research Laboratory Attn: Rdrl-Loc-I
Priority 2016-11-10 • Filed 2017-11-09 • Published 2018-05-24
A sintered cemented carbide body including tungsten carbide, and a substantially cobalt-free binder including an iron-based alloy sintered with the tungsten carbide. The iron-based alloy is approximately 2-25 % of the overall weight percentage of the sintered tungsten carbide and iron-based alloy.

Continuous acoustic mixer
WO EP US US20210069662A1 Peter Andrew Lucon Resodyn Corporation
Priority 2017-09-05 • Filed 2020-11-16 • Published 2021-03-11
A system for continuously processing a combination of materials includes a continuous process vessel having an outlet and one or more inlets. The continuous process vessel is configured to oscillate along an oscillation axis. An acoustic agitator is coupled to the continuous process vessel. The …

Glass-metal composites and method of manufacture
WO EP US CN WO2014197094A2 Carsten Weinhold Schott Corporation
Priority 2013-03-15 • Filed 2014-03-14 • Published 2014-12-11
The shaped composites of the present disclosure have metal powder bonded with glass powder. This feature provides the advantages of metal, metal powder, or glass composite materials, without suffering from the disadvantages. The composite is prepared with simple sintering methods, and can easily …

RELEVANT PATENTS
Technical Ceramics

Approved or pending applications for work involving the ResonantAcoustic® mixing technology.*

*With RAM as a preferred embodiment

Sintered polycrystalline cubic boron nitride material

WO EP US CN JP KR GB GB2560641A Can Antionette Element Six Uk Ltd
Priority 2017-03-15 • U.S. Filed 2018-03-13 • Published 2020-03-05 PCT / EP2018 / 056174

Abstract
A polycrystalline cubic boron nitride, PCBN, material is provided. The material comprises between 30 and 90 weight percent cubic boron nitride (cBN) and a matrix material in which the cBN particles are dispersed. The matrix material comprises particles of an aluminium compound; the matrix material particles having a d50 when measured using a linear intercept technique of no more than 100 nm.

Chemical-free production of graphene-reinforced inorganic matrix composites

WO US CN JP KR US10850496B2 Aruna Zhamu Global Graphene Group, Inc.
Priority 2016-02-09 • Filed 2016-02-09 • Granted 2020-12-01 • Published 2020-12-01

Abstract
Provided is a simple, fast, scalable, and environmentally benign method of producing a graphene-reinforced inorganic matrix composite directly from a graphitic material, the method comprising: (a) mixing multiple particles of a graphitic material and multiple particles of an inorganic solid carrier material to form a mixture in an impacting chamber of an energy impacting apparatus; (b) operating the energy impacting apparatus with a frequency and an intensity for a length of time sufficient for peeling off graphene sheets from the graphitic material and transferring the graphene sheets to surfaces of solid inorganic carrier material particles to produce graphene coated or graphene-embedded inorganic particles inside the impacting chamber; and (c) forming graphene-coated or graphene-embedded inorganic particles into the graphene-reinforced inorganic matrix composite. Also provided is a mass of the graphene-coated or graphene-embedded inorganic particles produced by this method.

By using resonance sound mixer to manufacture hard alloy or the method for metal ceramic powder

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Abstract
The present invention relates to a kind of method manufacturing hard alloy or cermet body, including being initially formed the step of following powder blend, this powder blend comprises powder and the metal adhesive forming hard constituents.Then use non-contact type blender that described powder blend carries out married operation, wherein use the powder blend that the sound wave realizing resonance condition mixes with formation, and then the powder blend of described mixing is suppressed and sintering operation.Described method is able to maintain that the granularity of WC particle, particle size distribution and form.

RAM 5 *Continuous*

RAM 55

*Omni***RAM** *Continuous*

RAM 5H

RAM 5

*Lab***RAM II** *Lab***RAM I**

*Lab***RAM II H**

*Omni***RAM**

*Pharma***RAM I** *Pharma***RAM II**

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