

Preparation Methods and developing Trends of Nano-Al₂O₃ reinforced

Aluminum Matrix Composites

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Abstract: The Nano particles have enhancing efficiency in improving the properties of aluminum matrix composites. Nano-Al₂O₃/Al Composites have high elastic Modulus, high strength with low density, and have attracted intensive attention and become a focus of the. The preparation of the nano-Al₂O₃-reinforced aluminum matrix composites is Presented in Detail, and the advantages and disadvantages of each preparation method are. Finally, the Development of Nano-Al₂O₃/Al Composites is also prospected.

Keywords: nano-Al₂O₃ , Preparation Methods , nano-Al₂O₃/Al Composites

21st century metal matrix Composites developed at the end of the decade (Metal Matrix composites , MMCs), by adding to a metal or alloy matrix High modulus , high-intensity , Hardened Enhancements , the composites prepared by can have effect Combining the advantages of the matrix and the enhanced phase , with high intensity , High modulus, High-tolerance The excellent comprehensive performance of, etc. . These excellent properties make metal matrix composites in clean Sky , Defense Industry , fields such as automobiles are widely used .

aluminum and aluminium alloys because of their small density , Low melting point , Good processing performance dot , easy to compound with enhancer and easy to two processing , is widely used as the base Body Material . in addition to, Aluminum also has a good conductive , thermal conductivity and good corrosion resistance , These are composite materials to meet the conditions of use must have the features , The makes aluminum matrix composites quickly developed [1, [2], [3] [4] [5]. Follow the increase strong body type , Aluminum matrix composites can be divided into particles , Whisker and fiber reinforced 3 species . where , particle reinforced aluminum matrix composites low cost , Isotropic , Preparation process Jane single , near year to become the most promising category of composite materials . aluminum matrix to add different kinds of enhanced particles , such as , Al₂O₃ , Y₂O₃ [3-- [4] [5] [6], TiC , SiC [all- [7] as well as CNTs [w- [8] etc . where , Al₂O₃ as a typical Ceramic particle enhancer , with high modulus of elasticity , High potential theoretical strength , excellent heterogeneous heat resistance and chemical stability , and low density , Wide , and Al matrix interface Good , No Harmful interface reaction , is considered an aluminum matrix composite's

Good Enhancements [9]. so , Al₂O₃/Al composites as a typical theory Research and Application research system , The preparation and properties of the aluminum base composite material is always material one An important topic .

for Al₂O₃ / Al Composite , The performance of depends largely on the Al₂O₃ Grain Volume score , particle size and Al₂O₃ The extent to which is dispersed in the matrix, etc. vegetarian . in General , Al₂O₃ increased particle volume fraction will make composite strong degree , modulus increase , The is also accompanied by a decline in material plasticity [%³]. based on orowan theory , The strength of the Composite will decrease with the increase in particle size of the reinforced body. Small and larger . micron Al₂O₃ particles as aluminum matrix composites enhanced phase can be

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Improve composite strength, But it also significantly reduces the ductility and toughness of the material. More and more studies show that, in the same volume fraction case, diffuse divide cloth nano Al_2O_3 particle compared to micron Al_2O_3 Granular, to the composite's Enhanced Efficiency. at the same time, Add nanometer scale Al_2O_3 Granular, can be used in significantly improve composite strength while retaining material certain plasticity. so, How to successfully prepare Al_2O_3 Evenly distributed nano Al_2O_3 / Al Complex The composite material has become one of the hotspots of recent years ..

1. Problems in preparation of nano-particle reinforced aluminum matrix composites

Nano Al_2O_3 / Al Composite with high modulus of elasticity, high-intensity

excellent performance such as, But the inherent physical and chemical properties of nanoparticles make nano - Al_2O_3 the preparation and application of the reinforced aluminum matrix composites are greatly restricted, mainly in:

(1) The problem of poor wettability between the nano-enhanced body and the matrix metal. nano Al_2O_3 The wettability of the enhanced body particles with the metal matrix is the preparation of nano- Al_2O_3 / Al Composites first issues to consider. nanoparticles surface easily adsorbed miscellaneous quality, Moisture, etc., can cause enhanced body and matrix wettability worse, To affect strong body binding to the matrix.

(2) Nano Al_2O_3 The particle has a higher surface energy than the, Compared to micro rice particles are more likely to be reunited during the preparation or forming process, to Reduce the effect of dispersion particles, Greatly affects the performance of composite materials. especially when adding high volume fraction nanoparticles, This issue is more pronounced. because this, to overcome nanometer Al_2O_3 aggregation of particles, improving nano Al_2O_3 on base the degree of decentralization in the body and Al_2O_3 The binding strength of the to the Matrix, people try to develop All kinds of preparation nano Al_2O_3 / Al methods for composite materials, wants to optimize the Preparation process to obtain nano with excellent mechanical properties Al_2O_3 / Al composite material material.

2. Nano Al_2O_3 / Al Preparation method for composite materials

The classifies the enhancements by the way they are introduced, Nano Al_2O_3 / Al Composite The preparation method of the material can be roughly divided into nano-from-outside add-in Al_2O_3 granule to The additive method in the matrix (Ex - Situ) and generate by reaction within the Matrix na

m Al_2O_3 in-place method for (in - Situ).

2.1 plus method (Ex- situ)

The addition method is to add nano to the base body from the external Al Method, main have powder metallurgy, Casting Method. a- Al_2O_3 get at high temperature Al_2O_3 stable phase, compared to other Al Sub - stable, a-Al on has a higher hard degree. so often added nano Al_2O_3 is A phase.

2.1.1 Powder Metallurgy High-energy ball Milling method

Powder Metallurgy High-energy ball milling method is a commonly used preparation of nano- Al_2O_3 / Al methods for composite materials. General atomized aluminum and aluminum alloy powders with nano Al_2O_3 Powder blending, then high-energy ball milling for mixed powders, suppress, sintering and Squeeze, Rolling processing, to achieve full densification of materials. composite "" final performance depends on Al_2O_3 volume score, Al_2O_3 Binding to the Matrix and nano Al_2O_3 The degree of dispersion in the matrix [1]. during ball mill 2 Procedure will affect Al distribution in matrix: _, Cold-welded To Increase the particle size of composite powders; Second, break process make composite powder end particle size decrease. Ball Milling will eventually exist this 2 The balance of procedures, and To adjust the balance of 2 procedures by Adding a Process Control. after long time ball milling, Composite powder continuous cold welding and crushing, Promote enhanced The body distributes more diffuse in the matrix, and reduces substrate grain size.

I. mobasherpour, and so on [2] A is prepared using a powder metallurgy high-energy ball mill A content to 1%, 3%, 5% (volume score) Nano Al₂O₃ / Al₇₀₅ composite. Their research shows that using high-energy ball milling method can be used to nano Al₂O₃ evenly distributed inside the substrate, Nano Al₂O₃ increases the content of The addition makes the matrix grains more fine-grained, and makes the Matrix Crystal distortion degree increase. The addition of Al₂O₃ greatly improves the mechanical properties of the material, 5% (Volume score) Al₂O₃ The addition of the increases material strength. 5%, but with Al₂O₃ content increase, The plastic reduction of the material. S. S. Razavitosi, and so on [2]

in Al₂O₃ added in % (quality score) 's nanometer Al₂O₃, studied the matrix organization in Ball mill Evolution, gets Al₂O₃ Diffuse distribution, grain full Sub-detailed organization. B. Prabhu [3] using high-energy ball milling methods, contrast | %, %, % (volume score) content nano Al₂O₃ in matrix Scatter effect. research shows, when high content nano Al₂O₃ add to Matrix when, The use of high-energy ball milling can still be the nano Al₂O₃ evenly dispersed in Matrix (as shown 1 shows).

Powder Metallurgy Bureau can ball mill preparation nanometer Al₂O₃ Enhanced Al Base Compound material has many advantages: first, to ensure that the nano Al₂O₃ can be evenly distributed in matrix organization; second, can flexibly adjust Al₂O₃ volume fractions, To improve Enhance effect; third, There is no harmful metal interstitial in the powder metallurgy process All objects. other, Powder Metallurgy High Energy ball Milling method Nano Al₂O₃ / Al Composite A major problem with the material is that the material must be fully compacted, to play an enhanced enhancement effect, However, the increase in the enhanced volume will bring about an increase in the difficulty of material densification.

2.1.2 Casting

Casting is a fabrication of micron Al₂O₃ / Al Traditional metallurgy of composite materials method. But when Al₂O₃ enhanced particle scale down to nanometer level, in System Prepare procedure, A nanometer-scale enhancer usually plays in the matrix of the liquid phase Strong reunion. This is because: first one, enhance body and substrate wettability worse; two, Because of the nano-scale of the enhanced body specific surface area is very large, so in the liquid matrix the surface tension in the makes the enhanced particles have a great tendency to reunite. enhancer at nanometer level Its density is no longer in the process of preparing composites Important. Although the density of the enhanced body is generally greater than the size of the matrix, But small increase strong particles tend to float on the surface of the liquid substrate [30]. so, need to take high-intensity The energy of the stirs the melt, to ensure that the nano-enhancer is divided in the Melt, ultrasonic Casting is based on the evolution of mixing casting. high-intensity ultrasound Create instantaneous hole effect, causes a burst of bubbles, generates internal impact, can break the reunion of nanoparticles, start Diffuse nano Al₂O₃ particle effect [4].

Li and its collaborators [4] The first method of ultrasonic casting was used to prepare granular Diffuse good 2% (Volume score) Al₂O₃ (<30 nm) enhanced Al 356 aluminum alloy. diagram 2 is its experimental device model. is based on this technique, S. Mula, and so on [10] To prepare the Al₂O₃ - 2% (quality score) Al₂O₃ (~ 10nm) Composite. The structure of this composite has nanometer Al₂O₃ continuously diffuse regions and Al₂O₃ Dilution Area, and Al₂O₃ Continuous dispersion regions are distributed along the grain boundaries, surrounds Al₂O₃ Dilution Area. composite hardness increased %, tensile strength increased near 57%. H. Su [5] Combine powder metallurgy and mechanical agitation, to First Al₂O₃ Powder and nano Al₂O₃ Powder mix for high-energy ball milling, plays a pre-dispersed role, then add the ball-milled powder to the melt mechanically stir, Finally, the melt is Ultrasonic stirring process, To prepare the Al₂O₃ Diffuse distribution of 1% (Quality Score) nano Al₂O₃ / 2024 Composite. The composite nano Al₂O₃ particle is distribute evenly across the matrix, and low porosity. with the above solid ^ Liquid Mixed casting The process effectively inhibits the agglomeration of nanoparticles in the matrix, and ultrasound applies not only to make molten composites get a tiny matrix when solidified. Microscopic organization, can also improve the dispersion of nanoparticles in the matrix; and Matrix Metals 2024 compared to, content is 1% (quality score) nano Al₂O₃ / 2024 the ultimate compressive strength and yield strength of a composite are increased by % and % I / %, Mainly due to the

uniform distribution of nano-enhanced particles and aluminum matrix

The problem of material densification in composite materials fabricated by stirring casting method, and with simple process, can prepare large products. But due to nano Al₂O₃ with melt poor wetting of the matrix, easy to cause coagulation enhanced phase matrix interface combine problems. Also, using ultrasonic stirring although can be in a certain degree on dispersed nanometer enhancer, however, the melt surface has a lower ultrasonic strength, ultrasonic scatter add nano Al₂O₃ inefficiencies such as the same exists [1].

There are also some additional nano Al₂O₃ Prepare Al₂O₃ / Al Composite method. C. M. Hu [2] Use the method of friction stir welding to apply the nanometer ruler degrees Al₂O₃ evenly dispersed in Al Matrix, To produce strength and plasticity with the ultra-fine grained composites enhanced by. for externally adding nano Al₂O₃ add strong Al matrix composites, The main factors that affect material performance for are: Al₂O₃ Volume fraction, Al₂O₃ The degree of dispersion in the matrix and the ability of the material to achieve full densification. so, guarantee Nano Al₂O₃ fully diffuse in matrix, Prevent agglomeration of nanoparticles, simultaneous densification of composites, on this basis add nanometer Al₂O₃ volume fractions, is an additional method for introducing Nano Al₂O₃ Enhanced performance requirements for aluminum matrix composites, is also out of the future Add the problems that need to be further resolved.

2.2 In-place method (in-situ)

Add Nano to the substrate from the outside Al₂O₃ The most important for methods of the The problem is that the enhancer does not bind to the substrate interface. [1]. through Al oxidation or a replacement reaction with some oxides introducing nano Al₂O₃ is the solution The effective way to do this is, the in-situ approach to Nano Al₂O₃ method. The reaction and subsequent processing temperature. It will not reach Al₂O₃ conversion temperature, generated Al₂O₃ eventually turn to Y-Al₂O₃. plus method join Al₂O₃ and in-place method introduces the Y-Al₂O₃ the difference between the enhancement efficiency of is currently is not explicit.

2.2.1 in-situ reaction technology

The In-situ reaction technology is primarily based on the matrix and some oxide reactions to generate the Nano Al₂O₃ to prepare nanometer Al₂O₃ methods for enhancing aluminum matrix composites. Al The replacement reaction with the appropriate oxides follows the following formula [34-36]: $3MO + 2Al = Al_2O_3 + 3M$

One way of in-situ reaction technology is to add a to the molten matrix SiO₂, CuO oxides, To generate nano by reaction Al₂O₃ and new alloys matrix. Dalian University Zhang Shouqi [4] Study adding to aluminum liquid (Churn entry) pre °C Bake 3 H, size is, SiO₂ particle, send

in-situ reaction to form a homogeneous particle distribution Al₂O₃ / Al Composite, reaction The restored silicon precipitates during solidification. H. Wang [5] CeO₂ Powder Add to molten aluminum, through melt reaction, to produce A particle size in the ~ / nm Nano for Al₂O₃ / Al Composites. as shown 3, generated nano Al₂O₃ Evenly distributes inside the base, Refine grain size, The increases the strength of the material material. researcher of the University of Chongqing [6] SiO₂ glass into aluminum melt through reaction synthesis Al₂O₃ / Al Composite, Its process is at a lower temperature can be done and react quickly, and overcome the composite Al₂O₃ / Al Composite Material The material usually uses particles as the limitation of reactants. Bin Yang etc [7] in molten matrix metal with oxide powder as raw material through in-situ reaction success prepare Al₂O₃ particle enhancement Al₂O₃ / Al, Al₂O₃ / Al- Si-Cu, Al₂O₃ / Al -Si-Cu -Mn and Al₂O₃ / Cu composites, overcomes the extra side add Al₂O₃ cause particle reunion problem. Experiment indicates network structure Al (Cu)-Al₂O₃ eutectic tissue is detrimental to fracture toughness and organizational stability, in Add two or more than two oxides in the preparation process, Can effectively reduce the eutectic organization.

Another way to react in situ is by using the Powder metallurgy method, to base powder, SiO₂, CuO powder Blending, Reactive Ball mills or reaction sintering, To generate nano Al₂O₃ reinforced aluminum matrix composites. Peng Yu etc [8] sintered Al and CuO powder, In-place reaction generation Y-Al₂O₃ Enhanced Al - Cu Alloy Base

composite material, after precipitation hardening and With the C Time Out, Vickers for composite materials hardness up to 114vhn, The ultimate strength can reach ~ 425 MPa, flexural strength up to 425 MPa, toughness up to . 9 J / cm², Composite Material material hardness, increase strength and even toughness. M. Tavoosi, and so on (五) will Al₂O₃ and ZnO powder blending after planetary milling H after, Reverse by substitution should generate nano Al₂O₃, To produce a with good thermal stability 5% (volume, number) Al₂O₃ / Al - . 8% (quality score) Zn Composite material. H. Aami, and so on [1] to Al and CuO Hybrid powder for high-energy ball milling, studied the ball milling process

The evolution of powders in and Nano Al₂O₃ generation of, to produce a diffuse distribution of Al₂O₃ / Al-Cu Nano-composites.

diagram 3 Casting the Al₂O₃/Al Composites Al₂O₃ granular Scan

Electron Microscope organization and EDX parsing: morphology and dispersion distribution of particles in composite materials

(a); Select a region's EDX parsing (b); EDX Profiling results (c)^[3]«

Fig. 3 SEM microstructure and EDX analysis of particles

In the As-cast Al₂O₃/Al composites: distribution and Mo Wide

phology of particles in composites (a); EDX Analysis of the

Selected Area (b); EDX analysis Result of the particles (c)^{C38}

In-situ reaction technology for preparing nanometer Al₂O₃ reinforced aluminum matrix composites, because of the The Enhancer is a Thermodynamic Stable phase that is grown from the metal matrix in-situ nucleation, and Surface no pollution, avoids problems with poor substrate compatibility, Enhanced Body with the matrix well; at the same time controllability, can reasonably choose reaction element (or compound) type, component, to Achieve effective control in-place build enhancer Kind, size, distribution and quantity purposes, and Guarantee nano Al₂O₃ in matrix dispersion Distribution. but, the temperature required for the in-situ reaction is generally compared to high, the reaction may produce some harmful brittle intermetallic compounds, So control reaction product is the problem needing attention in in situ reaction.

2.2.2 Natural oxidation (Powder Metallurgy)

in the process of preparing aluminum matrix composites in powder metallurgy, Al powder is extremely easy to occur passivated, to form a continuous amorphous on the surface of the powder Al₂O₃ Film. This is even though Yes to get pure Al powder, but also synthetic in situ nano Al₂O₃ add Effective method for strong aluminum matrix composites [1]. Al powder surface generated amorphous Al₂O₃ Film thickness general 5 ~ 10nm, in powder metallurgy hot pressing, sintering procedure, amorphous nano Al₂O₃ The film will change to Y- Al₂O₃, for material to intensify with.

The earliest use of Al powder Surface naturally oxidized Al₂O₃ to enhance the aluminum base The material is sintered aluminum. the first of the sintered aluminum is from R. & 1 ! 1 £ 0 ^ [' '] on 1949 Year as structural material developed, Its preparation process can be divided into 2 Section: Preparation of aluminum powders and extrusion of aluminum powders. Several decades after the advent of sintered aluminum, Researchers have been working on this material from a theoretical and experimental perspective in a wide range of studies. early sintered aluminum powder from the main source is atomized powder, turning powders and Balls Matte aluminum, etc. aluminum powder in air oxidation generated Al₂O₃ content is not the same, where atomized powder Al₂O₃ minimum, to 0.1% ~ 1.5% (Quality Score). The addition of the Process Control agent during the grinding process of the ball will inhibit cold welding of powder occurrence, To promote powder Continuous refinement, make powder overall surface area increased, to introduce more Al₂O₃, powder after ball milling Al₂O₃ The content is roughly 6% ~ % (Quality score) [1]. aluminum powder is pressed to form a cold pressure on the oxidized aluminum powder, then after sintering, Hot Pressing, and then machining variants to produce different kinds of structural materials Material^[4446]. machining

variants can Al₂O₃. The membrane is broken and evenly dispersed in the material internal, to play the role of oxide dispersion hardening. Al₂O₃ can also be to effectively inhibit the recovery of material in the process of deformation recrystallization, Refine grains, and and increase thermal stability of materials [5]. development of mechanical alloying, make preparation Complex system of alloy powder become a reality, And the use of alloy powder for the matrix can be get better performance of composite materials. such as Al₂O₃ Diffuse hardening Al - Cu - Mg Material [6], the strength at room temperature can be up to Al ~ 440 MPa, extension to 7%, 6% ~ Ten. 9%, and the temperature reaches °C when, still has a better performance, Therefore, as a manufacturing engine cylinder piston material is widely used in. France researcher use Al- 6.2% Zn - 2.5% Mg - 1.5% Cu - 0.4% Co Alloy body Department [7] sintered aluminum alloy developed by, strength up to 650 MPa, extension reached 8% ~ 9%, and extremely high fracture toughness, High fatigue strength, Good anti- Wear performance. because sintered aluminum alloy products have a good temperature and high temperature. Learning Performance, and by selecting different components of the alloy powder can be flexible adjustment of the material performance of the material, is widely used in engine, Clean and empty parts area.

In recent years, as the need for toughening of composite materials continues to improve, modeled after Fine structure of organisms in nature, optimization design material microstructure, thereby Improving the mechanics and physical properties of materials, in the composite field get Extensive research on. Flake Powder Metallurgy is a successful system developed in recent years Powder metallurgy method for preparation of biomimetic nano-laminated aluminum matrix composites. L. Jiang, and so on [8] use surface oxidized nanometer flake aluminum as raw material, Use Powder Self-assembly to prepare the nanometer stack of shell-like structures Al₂O₃/Al Composite. diagram 4 Flake Powder Metallurgy preparation of nano-laminated layer Al₂O₃ / Al Composite Process diagram. Research shows, this nano - overlay Al₂O₃/Al Composite with good strength and plasticity match, tensile strength 262 MPa, simultaneous extension rate reached. 9%. This good combination of strength and plasticity, may be by to two-dimensional sheet Al₂O₃ better suppress Al grain growth, at the same time the, nicely retains the laminated structure of the material. X. Horizon Wait [9] using Flake powder metallurgy Gold Crafts prepared B₄C /UFG al (Al₂O₃) composite, Research indicates that in the sheet powder metallurgy Process, Further ball milling enables sheet-like Al powder surface from But generated Al₂O₃ diffuse distribution to base grain, To increase the extra fine the dislocation storage and processing hardening capability of the crystal matrix, Improved the Uniform deformation ability of the ultrafine grained composites. N. O Port [10] in Jiang on the basis of, Research the nano-laminated coating prepared by flake powder metallurgy Al₂O₃ / Al Laminated Sheet thickness-to Al₂O₃ The shape of the 3 and the effects of distribution in the matrix. Flake powder Metallurgy process Nano Al₂O₃ / Al Composite can implement the composite's configuration design, Adjust Al₂O₃ Space Distribution, and can guarantee that the Al₂O₃ and Matrix good combination, fully compact material.

sintered Aluminum from traditional powder metallurgy (Nano Al₂O₃ Diffuse enhanced aluminum base complex material and Flake powder metallurgy method for preparing in situ nano Al₂O₃ / Al Composite material has something in common. , same time difference. two ways To change the state of a powder by using the the ball mill, can also change the Al₂O₃ Content, and The has a similar process flow. Traditional method to prepare nano Al₂O₃ / Al Composite Material material through long ball milling, Achieve powder cold welding and crushing equilibrium state, will Al₂O₃ diffuse distribution inside matrix, also changes the powder shape to isometric granular for. the materials produced by the are evenly organized, isotropic. "" PM Powder Metallurgy is in the powder preparation process, preserves the sheet shape of the powder states at the same time as the super fine grained nanocrystals, keep aluminum grains in favor of dislocation Movement of long crystals, keep composite material in good shape. also, movie like Al₂O₃/ Al powder can also be used as a matrix, For toughening other particle enhancements system (as b₄candSiC etc), through flexible adjustment of aluminum sheet thickness, Al₂O₃ form appearance and distribution, achieving The goal of toughening the material configuration, is metal base The toughening design and preparation of composite materials provides a simple and effective way to.

There are some in-situ preparation of Nano Al_2O_3 / Al methods for composite materials, than such as electron beam deposition, anodizing etc. A. T. Al_{pas}^{*[wuyi]} using an electron beam The method of deposition prepared a laminated structure of nano Al_2O_3 / Al Composites. to deposit on glass sheets Al layer, will Al layer exposed to air for oxidation to continue deposit, Loop to produce a different layer of nanometer Al_2O_3 / Al re combination material. The strength of the composite depends on the thickness between the layers, layer thickness $\$ nm$ when, The strength of the material reaches the maximum 450 MPa, and material has good Good thermal stability and fracture toughness. R.. Jamaaii, and so on [1] using anodic oxidation method, on Al plate surface oxidation generation Al_2O_3 Film, The rolls through the cumulative stack to Al_2O_3 membrane fragmentation and dispersion within the matrix. results show, increase the number of iterations to promote Al_2O_3 spread more evenly across the matrix. W.. Xu, and so on [3] to fresh Al Powder and Drop [1] ~ Month A 1 powder in °C, MPa under pressure Reverse equal channel Corner extrusion, Prepare compact Nano Al_2O_3 / Al Composite material. during powder suppression, amorphous Al_2O_3 to $\gamma - Al_2O_3$, for Materials Average grain size is about 110nm, Material Ultimate Compression strength can be reached 740 MPa. These in-situ preparation nano Al_2O_3 / Al Composite Methods Limited to unable to produce Large size samples, The is therefore not widely studied.

3. Epilogue

Nano Al_2O_3 / Al Composite as a typical nano-particle reinforced metal matrix composites are important material systems for theoretical and applied research. In recent years, knot The traditional process of preparing micron-level particulate reinforced aluminum matrix composites developed a Multiple preparation nano Al_2O_3 methods for enhancing aluminum matrix composites. generally, In-situ reaction method is easier to get good interface combination, powder Metallurgy The Jim Fabi casting method is more conducive to solving the problem of dispersion of nanoparticles. and Powder combination of metallurgical and in-situ reactions, can be asked in the resolution of nanoparticles dispersed The alloying of the aluminum matrix at the same time as the problem., get more high-strength composite material material, to prepare high performance Nano Al_2O_3 effective side of reinforced aluminum matrix composites type.

Previous studies on nano-particle reinforced aluminum matrix composites, Is typically the introduction and distribution of the rice particles as a regulatory target, less attention to tissue tuning of aluminum matrix control. In recent years, super fine crystal, Significant progress has been made in the theoretical study of the nanocrystalline materials, The nano-particle reinforced aluminum matrix composites with the super fine crystal, nanocrystalline as matrix will be for future lightweight aluminum matrix composites development Important direction, and Superfine The toughening and organization stability of the crystalline matrix will be the focus of new research. another aspect, Although traditional homogeneous structural composites require in the preparation of nano Al_2O_3 / Al composite Process guarantee Nano Al_2O_3 dispersion distribution in the matrix, but The is a combination of current metal matrix composites development trends, by changing the augmented body's space distribution, Adjusting the composite configuration of composites, Prepare non-homogeneous structure naM Composite will have better toughening effect. Recent films PM Process, to effectively adjust the spatial distribution of nano-reinforcements, Refine matrix grain size, For the composite configuration control and strengthening and toughening design provides a effect of the preparation technology and regulatory means. so, Flake powder metallurgy process as Na rice particle reinforced aluminum matrix composites The new technology has great development. Null Room. and nano Al_2O_3 / Al whether as a separate material system or as its He particle reinforced aluminum matrix composites the substrate, are expected to get better in the future Development and extensive application.

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