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Development status and challenge of advanced resin matrix composites

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Abstract: Advanced resin matrix composites have become one of the most important aerospace structural materials.The mainly introduces the advanced resin base composite material at home and abroadmaterial Enhanced fiberresin matrix,Development of manufacturing technology and structural functional integration Technology,and evaluation of advanced resin matrix composites,and pleaseDiscusses thedevelopment trends and opportunities and challenges facing advanced resin matrix composites.advanced resin matrix composites development Current opportunities and picksWar has:resin matrix composites continue to develop in High-performance;structural function integration of resin matrix composites presents versatility and cutting-edge trends;Isbased on multipleComposite design techniques for scale modeling and characterization usher in an extremely important development opportunity;versatility becomes an important target for future development of carbon nanocompositesMark;environment-friendly birth of green composites,thermoplastic Composites and efficient recycling technology;Smart Composite Technology supportslarger,more integratedThe reliable application of the overall structure of composites;Internetage composites will face profound changes in research methods.

keywords: Advanced resin matrix composites;Trends;Enhanced Fiber;resin Matrix;Manufacturing Technology

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Advanced resin matrix composites are made from organic polymer matrix materialscombined with high-performance fiber-reinforced materials through a special molding process2or 2 phaseabove fabric,has performance to setcount,High specific strength and stiffness,Good fatigue,Corrosion-resistant,can be wholeMolding and versatility_Body Benefits,in areas such as aerospaceapply Yue yi wide,has developed into the most important kind of structural materialmaterial and structural features integration materials.in advanced civilian-military use largeairplane(such asB787,AupandA?Maircraft"Middle,CompositeThe amount of is up to40%~50%.onf22,F$andEF%ranking4generation fighter,Composite amount reached20%~40%.The amount of composite material used in helicopters is up tothe90%[4].

This article mainly introduces the domestic and foreign advanced resin matrix composites enhancementfiber,resin matrix,Manufacturing technology and structure features_body TechnologyDevelopment,and Advanced resin matrix composites review Application Status,Discussion on the development trend of advanced resin matrix composites and its faceopportunities and challenges.

1. High Performance carbon fiber serialization and industrialization,HighPerformance Organic fiber gets rapid development

Advanced resin matrix composites mainly involve carbon fiberd,High Performance organic fiber and fiberglass,due to domestic and foreign glass

Glass fiber early inmore matureat the beginning of the century,This section is primarilydescribes the development of carbon fiber and high-performance organic fibres.

Carbon fiber includes polyacrylonitrile base,pitch and glue base3typesystem,polyacrylonitrile carbon fiber High performance,Alarge amountof,is highto the core of carbon fibers.Japan and United States on polyacrylonitrile carbon fiberfield technology aheadof the,Japan Toray(Toray)Company has successivelyform high

strength(the),Highmodulus(M)and high-strength high modulus(MJ)3products[Series,Dorset(Hexlec)Company also developed high strength(asandIM)product.Japan toray,East State(ttoho),threeLing Rayon(Mitsubishirayonand)US Hexel(hexcel),como(Amoco),Drow(zoltek)6A company's total production of carbon fiber in the world, respectively, and the general market80%and85%above[all].diagram1for domestic and foreign parts high strengthMechanical properties of the-type carbon fiber.

While carbon fiber is high-performance,,to reduce carbon and carbonFibre prepreg manufacturing cost,Carbon fiber companies are developing bigtow Carbon fiber.American Drow Corporation is the first in the world to researchsystem,develop and produce cheap,High Performance large tow carbon fiber company.The current drow giant tow carbon fiber in the Civil industry fieldLarge scale Applications.Toray in the original700-12KandTT800-12KCarbon fiber based on,the further develops theK Carbonfiber,and onBoeing787largepassenger aircraft use.

from15since,High-performance carbon fibers in China are quickly issuedshow,,300Grade carbon fiber performance to the same foreign carbon fiber waterping,has achieved stable production and is in aviation,space Equipment implementation should bewith;Tmgrade carbon fiber performance requirements,Engineering preparation KeyTechnology Breakthrough,testedin aerospace equipment;T?-Grade carbon fiber preparation key technology has basically broken through,Gets theperformance requiredilevel carbon fiber,working on engineeringResearch and assessment validation.

The Aramid consists mainly of Aramid and para-aramid.United States dutheState Company takes the lead in achieving the position of Aramid and para-aramid largeScale industrialized production,Their production capacities are2million ton/year and3million ton/year,is the global total capacity of75%and50%,The forms aNomexandKevlarCommodity Series.Japanese Emperor,UniOdd Card and the company of the Netherlands AkzoNobel also has aramid industrial hygieneproduction capability,capacity second only to DuPont.Korea,Russia and GermanyCountries are also vigorously developing the capacity building of Aramid industry,but meshbefore total annual output is less than5thousand ton.The capacity of the domestic Aramid fiber has reachedto ton/year,product Performance Basic stable,to bit aramid thousand ton classproduction line has beenput into production,But product performance and stability haveyet to beApply Validation.Russia and China also developed thearamid fiberswith ternary monomers,performance is significantly better thanKevlararamid,but PriceHigh,primarily for defense field[7-.also,various featuresThe Aramid products of are also developed successively,For example,Dili technical production

Product company developed a stable performance of aromatic amide nano-fiberNonwovenscloth,on°Cmaintain heat and dimensional stability at elevated temperatures,Good oxidation performance,for lithium ion battery diaphragm.table1toBasic performance of some high-performance organic fibres.

Poly (phenyl) diphenylbis (ribavirin)(PBO)Fiber is a comprehensiveperformance Yu Fang fiber-a high-performance organicfiber,now Japan EastForeign Textile Company is the only one that can proceedPBOFiber Commercial productionEnterprise,outputto +ton/year,main military only to EuropeUS sales.PBOFiber-reinforced composites mainly used in armoured vehiclesCar,fighter,ship and soldier Protection equipment.pipdfiber(M5fiber"Isall called poly[2,5-two hydroxy-1,4-benzene pyridine andtwo imidazole""]fiber[14-17.M5Fiber has withPBOfibre phasesimilar to high mechanical properties and heat resistance;Isalso due to the intermolecularand numerator withN-H...OandO-H...NStructure,hasbetter compression performance and shear performance,especiallyM5fiberThe high polarity of the surface of the dimension makes it easier to glue to various resins,becauseof theThis has a wide range of applications in the field of high-performance resin matrix compositesforeground[18-20].

2. Composite mechanical Properties,toughness,High temperature performance andprocess Comprehensive promotion

to meet aviation,Aerospace and other fields of resin matrix composites synthesisCompliance requirements,composite resin matrix continuous development,FormsHigh performance resin matrix with different

toughness and different use temperatureSeries,especially high performance epoxy,Bismaleimide and polyimide theamine resin matrix composite is widely used[21-24].

Epoxy and bismaleimide resins are the most commonly used resins for compositesmatrix,with process good,Corrosion-resistant,high mechanical performance and toughness goodfeatures.epoxy and bismaleimide resin matrix composites can be in130Cbelow and175~230CLong-term useof.for material temperatureLow level aircraft structure,Basic Epoxy resinComposite material main,for heat-resistant aircraft and missile ownersto load structure,Mainly used double horse resin base composites,United Statesquad-generationF-22Theamount of composite material is the of its structural quality24%,where70%is a two-horse resin matrix composites.

Polyimidecomposites have excellent synthesis at elevated temperaturescan,on280~450°CLong-term use of within the temperature range of,But process and toughness are significantly lower than epoxy and dual-horse composites.hot[]solid polyimide resins can be divided intoPMRtype,Petiand cyanide-terminated polyimide, etc.,launch in aviationlarge applications in cold end parts and aircraft high temperature structures.

Carbon fiber reinforced composites in impact load(is mainly low speedImpact)often prone to layering damage,Composite ToughnessIncrease improves its ability to impact damage[--All.passyearDevelopment,Epoxy and bismaleimide composites toughnessafter initial impact remaining strength(CAI)to1 ⑻ ~180MPa,The is progressively raised toCAIis245~315MPafor2generation of high toughness complexComposite material[28-32],current3Generation Ultra high toughness compositesCAIhasreach315MPaabove[3].diagram2for domestic and foreign parts high sexcan use the carbon fiber composite for temperature and shock compression strength.

Themain development trend of high temperature polyimide resin matrix is to makethewith increasing temperature.page1generation of polyimide composites longperiod temperature is316~ [*]C,Typical rep with us countryNASA(NASA)Research and development1widely applied to aviationenginePMR-,andLP-15,KH304,BMP-316Polyimide[34-38].page2CommodorePMRTemperature-resistant ofpolyimidelevel315~370C,such asPMR-II,V-CAP,AFR-700,MPI-1andBMPAll, and so on[39-43].page3generation of polyimide resistancetemperature rating370~426C,likeAfrpe-4,RP-46,dmbz-andPI-400etc.page4generation of polyimide heat resistancelevel426~C,such asP2SI9⑻HTPolyimide[44-45].

to reduce composite cost of composites,fromcenturyLow-cost liquid-forming composites technology has been widely used since the ageofwith, andits adapted resin transfer moulding(RTM)resin obtainedQuick Development.Minnesota Mining and manufacturing company(3Mcompany)

175

Working temperature/°c

diagram2The use temperature of some high-performance carbon fiber composites at home and abroad and Compressive strength after impact

Fig.2WorkingtemperaturesandcompressivestrengthAfter ImpactofsomehighperformancecarbonfibercompositesAt Homeandabroad

forPRThe resin has been applied toFandFFour-generation fighter,

hexcelCompanyRTM6has been applied toB787andA380Largeaircraft.In fact,cyanide(Cytec)andhexcelCompany hasLaunch series epoxyRTMTree system:fordifferent use temperatureEpoxycycomPR520,RTM(%Clong wethot use),cycom823RTM($CUse),CY-COM875RTM(serviceCuse),cycom890RTM(Cuse)and epoxy for aerospace structuresRTMresincycom5555RTM(140CLong term use).HexcelCompany launchRTM650andRTM651double horseRTMresinsystem.NASAResearch available throughRTMProcess-molded ethylbenzeneacetylene phthalic anhydride(4-pepA)end polyimide resin matrix①positive d-298,peti-330,peti-375),Its process performance is good,has a morehigh heat resistance and good mechanical properties.

3. Composite Component Automation,Digital,Integration andLow cost manufacturing technology maturing

Advanced Resin Matrix Composite molding technology development diagram asshown in3"show."early advanced resin matrix composite molding with prepreg hand shoppaste Hot pot Forming main.The advantages of the hot-pressing tank molding technology are the compositematerialperformance high,Stable quality and suitable for large complex profilesmaterial Widget's molding,Disadvantage is large device investment,High energy consumption and manufacturingcost Highthe[46-49].pre-impregnation hot-pressing cans molding technology latestDevelopment is with digital,combination of automation technologies,with PrepregAuto trim and laser positioning Assist overlay Technology,improves manufacturedThe automation level of the process and the molding process level of the hot pot,ImprovedComposite widget quality[50-51].

CompositeRTMTheprocess does not require the preparationof Prepreg,FirstPlacea fiber or fabric pre-forming body in a closed stencil,then treegrease Matrix direct injection,finally get near with excellent comprehensive performancenet size composite parts.with traditional hot-pressing can molding technologyvs,RTMprocess to reduce manufacturing costs40%around.for entering_step to increase production speed,Improve product quality and reduce product manufacturingcost,inRTMA series of improvements are made based on the process,SendShow vacuum-assisted delivery moulding(VartmorVARI)hot-inflationexpansion resin transfer moulding(Tertm),,resin film soaked in molding(RFI),Continuous Resin pass Molding(Crtm)/Total injection modePlastic(rirtm)andseemancomposite resin infiltration moulding(scrimp)etc[52-55].

with the continuous application of high-performance resin matrix composites,Composite component dimensions are also getting bigger,appearance getting more complexMiscellaneous,greaterdegree of integration,relies on manual overlaysfor a difficult implementation technical requirements and production of large complex monolithic composite components

Economic requirements for efficiency,Auto-tape and tow-Placement automationPlacement technology has been developed quickly,andB787,A380,AAllwings for and soon,fuselage,Large main load structures such as the central Wing are widelyapply.

Auto-tape technology to trim a one-way prepreg,ToLocatethe,Shopstacks,automatically complete on automatic belt conveyor,in the overlay processMulti-axis gantry manipulator complete automatic placement of belt position,Shop Leadtoimplement a pre-leaching belt transport,cut,,overlay,compaction process.auto WireBeam placement technology is based on winding technology and automatic ribbontechnologydevelopment of,is the advantage of fusing winding technology and automatic ribbon technologyComposite Automation Manufacturing Technology.automatic wire Harness technologystrongadaptability,can be included like a bump surface,Open,Theexact placement of complex workpieces such as detail structures with ribs, to achieveComplexautomatic manufacturing of complex structures of materials[to].

Pre-leaching extrusion(advancedpultrusion,ADP)Technicaldeveloped on thebasis of traditional pultrusion processesinto composite automation manufacturing technology,apply to manufacturing various compositeThe profile for the material.Pre-dipping technology is to introduce prepreg into the1heat and pressure stencil,then goto1Curing Furnace to solid,,Traction device to send cured product to cutter,by Customerrequire cutting and trimming products,last entry1AutomationThe ultrasonic defect detection device for, checks for quality checks.current AirbusA300/310/320/330/340aircraft composite vertical stability
face Long truss andstiffeners,and size5MX0.+mA380The main bearing fuselage floor beams are extruded by Prepreg technology

make Yang-[2].

4. Comprehensive evaluation of structural composites full,application areaand performance continues to expand and improve

resin matrix composites passyears of development and application,creates a_set from sample,symbol,typical to widget design analysisand"buildingblocks"Evaluation Validation Method,Building Composite Widget'sDevelopment Specification,Ensuring reliable application of composite structures.compositematerial"Buildingblock""Check verification method Figure4[]isshownin.

from the7 6year start,TheUnited States and Europe have a large number of specializedGate Schedule,composite resin matrix composite technology and knotConstruct evaluation.table2for some foreign composites technical reviewValidation Plan.

Theverifies the resin matrix Composite in the fly by using these planning systemsmachine rudder side structure,main structure of wing and fuselage,Low-cost technologyThe reliability of applications such as and efficient overall architecture,greatly facilitated compositematerial application,for advanced resin matrix compositesB787,ALarge numbers of applications in airplanes such as all lay a solid foundation[all].diagram5toairbusSeries aircraft composite Applications.with evaluationvalidation and application experience accumulation,Composites from early non-load-bearing structures

The application of the gradually advances to the application of the large main load structure.

Composite Applications in the aerospace industry[%]As shown infigure6shows.thecurrent advanced fighter composite material amounts to its structural quality

25%above(See figure6 (a)),Large civil aircraftA380,B787,AAllThe amount of composite material is up to25%, 50%and53% (See

diagram6(b)),new HelicopterV-22,RAH-66,NH-CompositeThe dosage of the material is up to78%, 90%andabout $[out-](SeeChart6 (c))).

Advanced Resin matrix composites in addition to the large number of aviation areas should bewith outer,in space,The has a large number of applications for weapons and ships as well..advanced resin matrix composites have formed the shell,Space and internal pressur

Table2Part of theForeign composite Material Technology Assessment Validation Program

Table2TestandverificationProjectsofsomecompositesTechnologyabroad

Test and Verification Project test and verification content

Acee (aircraft energy Technologyto design,manufactureand testof secondary load-carrying composite structure.The major

efficiency test samples include Lockheed L-1011 aileron,Douglas DC-10 rudder and B727 wing *et al*.

lowcost Technology of Composite primary load-carrying structure,including fabric preform,Liquid Composite Molding (RTM,RFI),Automated tape laying,Composite damage Sensitivity,Durabilityand

Fracture mechanics.The major test samples are fuselage pressure cabin and Stitched/rfi Box *et al*.

TheTechnology of integration,Automation and low cost forlarge composite primary load-carrying

structure involves large size wing,Design andmanufacture of fuselage structure,Integrated Application of the new Lowcost technology ET.The major test samples are integrated wing and fuselage.

Technology ofmanufacture,Assembly and testing of integrally stifened panel (with thickness up to mm) of composite Centre wing involvesOuter wing RTM,rfi/lri Molding,Composite/metal Hybrid Drilling and assembly.The major testing samples are composite the wing box and fuselagesection

E al.

Integrated verification of composite wing and body involves aul^oma^edtape laying,diaphragm forming,alcascadvanced and lowNCF Fabric Composite Liquid Molding (RFI,VARI,RTM technology,NCF Fabric Prepreg/outof

Cost airframe structure) autoclave ow pressure molding technology and composite *et al*.The major test samples are

Composite wing and Body *et al*.

+lusclage

Shell3Large Space Structure Composite series,and liquid molding,automaticand efficient automated process for winding and automatic placementapplication of composite materials by small size secondary forces such as missile and satellite bracketsstructure to launch tube,Large size main bearing structure spanning.in weapon field,Advanced resin matrix composites in tank armoured vehiclescar body,Turret Large Structural armor component,Arrow Weapon engineShell,nozzle,tail fin,Combat Unit,fairing,radome,Firethe gun barrel and chassis begin to receive a large number of applications.in ship's collar

Field,Istypically about~mYacht,Speedboat,Hunt/Minesweeperand large and medium ship superstructure,Standalone structure,protection structure,Thestructure of the pressure-resistant shell and the secondary bearing structure in the cabin are combinedMaterial Manufacturing.

5. structural function Integration composite material formation Basic Series,technology Matures

resin Base structure features_Thebody of the composites consists mainly of the structuresuck/through Wave,Anti-elastic and thermal composites.in high-performance architecture/throughWave integration composites,has developed with high-strength fiberglassdimension,quartz fiber andKevlararamid as enhancement material,with ringoxide,cyanate ester and double horse as resin matrix lightweight high-strength Structure/Wave-through-MatrixComposite system,establishes a complete structure/Wave-throughmechanical properties and wave-penetrating properties of composite materials database,preparedThe radome of the has a higher radar wave transmittance and a smaller sidelobe,in various aircraft,Ground Communications station,fields such as ships and vehicles getWide application.in structure/absorbing integrated functional composites researchaspects,have formed laminated and mezzanine structures2Large class structure suction–body composites,Long-term use of the temperature reached170°C,absorptionfrequency range overrideC,X,/SandKuband,and in the new stealth MountA large number of applications in the absorbing structure,obviously improved equipmentSave Ability[all-,.

Organic fiber reinforced structural resilient composite with high protectionperformance and specific energy absorption.aramid Fiber reinforced anti-elastic composite in the United StatescountryMlseries,Russia,-72,T-and JapanTankiswidely applied.ultrahigh molecular weight polyethylene(UHMWPE)fiberdimensionalEnhanced anti-elastic composites less directly used for vehicle's anti-elasticity installationA,And more for armored vehicles against detonation and two effects protection within the-lined and human armor.PBOFiber as resilient composite materialprimarily used in armoured vehicles,fighter and ship,USOak LinHome LabsalsoPBOFiber reinforced anti-elastic composite withon Personal protective clothing[all].

resin based structural heat-resistant composite materials with ablative propertiesgood phenolic system as the preferred resin basefor heat-resistant compositesbody,has developed a hand paste,prepreg molded and wrapped3class Process,and high-silicon oxygen/phenolic,Carbon/phenolic and advanced carbon/Phenolic3Foundrymaterial,basic low gradecorrosion rate of resin based heat-resistant compositesrate(line ablation rate<0.4mm/s)and ablation Shape control,fullFull High performance reentry vehicle,Planetary detectors and high-performance solidsThermal protection requirements for aerospace devices such as engines[70-73].phenol-formaldehyde base composites while meeting the application requirements for thermal materials,with itsExcellent flame retardant properties quickly to air,ship,E and transportationetc Industry Extensions.

6. Advanced Resin matrix composites opportunities for development andChallenge

6.1 resin matrix composites continue to develop in High-performance

resin based structural composites by increasing the strengthof the,toughness,anti-damagedamage tolerance and

temperature resistance to achieve structural load-carrying capacity, anti-EnvironmentImprove performance and impact performance,continuous high-performance development.Requirements for the development of ultra-high speed aircraft,United StatesNASAandBoeingCompany Cooperation,Todevelop high temperature and toughness polyimideResearch on Amine composites,developed a long-term use temperature greater than200°CHigh temperature and toughness of composite materials.for further improvementThe use temperature of resin matrix composites,launched the first4Generation temperature4 50COrganic-inorganic hybrid polyimide composite resin matrix Researchinvestigate,Initial glass transition temperature upto425CLonger-used4generation of organic and inorganic hybridizationP2SI9⑻HTPolyimideComposites.

The cost of the resin matrix composites has been restricted to its civilian collarThe main reason for the domain scale application is_.with low cost carbon fibertechnology Development and liquid molding,wrapping and Automatic paving moldingapplicationsfor efficient technologies,Advanced resin matrix compositesThis will continue to decrease,Structural composites industry has also spannedThe new phase of the drive cost reduction with continued expansion.advanced resinmatrix composites not only in the aerospace field the proportion of applications is substantially increasedhigh,also to energy,Traffic,Civil collar for engineering construction and sports Leisuredomain rapid infiltration and scale expansion.theCivil industry has gradually been issuedShow the leading strength of advanced resin matrix composites industry.

6.2 structural function integration resin matrix composites rendering Multifunctionand cutting-edge trends

structure absorbing composites by introducing a new wave absorbing mechanism,in_steps to improve low-frequency wave absorbing performance,use temperature and mechanical properties.basetoSuper MaterialThe structure of the absorbing composite material significantly expands the broadband suctionAccept Properties,Implementation Absorption frequency range overrideP,C,X,SandKuband,Thesignificantly improves the low-frequency absorption of structural absorbing compositescan be.based on"Super material"The structure of the wave-penetrating composites will change completelycurrent radar radome design idea,Toimplement multiple-frequency and transparentwave/wave-absorbing integration,and research through the mechanism of correlation heat and heat transferinvestigate,improve high power density performance and high temperature resistance,to meetHigh power launch requirements.

Structural anti-elastic resin matrix composites will use carbon fiber and polyphenyleneBase benzene double-Methylimidazolium(PBO)Fiber as primary enhancement,Enter aStep to increase the rigidity of the part,protection performance and mechanical performance and developmentcomposite bodywork,Overall manufacturing technology for large parts such as turret.

Heat-resistantcomposites with phenolic resin matrix will be low density(<0.5g/cm^3)Material Series extension,by reducing material densityimproveThermal efficiency,increases the strength of theresin baseHeat-resistant compositesand thermal structure reliability.

6.3 Composite Design technology based on Multiscale modeling and characterizationUsherin an extremely important development opportunitybased on molecular link,key angle and complex molecular structure Assembly fieldComplexity of the molecular structure model established by(Epoxy resin matrix complexof the atomic simulation model as shown in the diagram7shown),Current computing power enablesMolecular dynamics simulations are limited by scale and atomic number.however,With the continuous rapid enhancement of computing power,can imagine this complexModeling the molecular structure of is possible in the future.calculation material modeling savein an extremely important development opportunity,can not only guide new aggregationsSynthesis of objects,and can perform composite structure failure ultra high precisiondegree forecast.The calculated material method can provide a periodic payloadinvalidation process with material,Statistics for the geometric structure and load conditional relationshipsBehavior Base.afterestablishing the physical and chemical properties of the polymer matrix andtheDirect relationship of the composite structure performance,Calculated material methodEnough to develop new polymers to

meet future more advanced body knotconstruct requirements,and for composite knot through calculation analysisconstruct authentication, thedrastically reduces the size of the authentication experiment[?].

6.4 versatility becomes future heavy carbon nanocomposites developmenttarget

carbon nanotubes and graphene have excellent mechanical properties,Conductiveand thermal conductivity,and polymer matrix composites should be able to change significantlygoodness includes properties of carbon nanocomposites, including mechanical properties."" andearlier results were not consistent with expectations.first,on compositeprocedure increases with physical size,carbon nanotubes and grapheneperformance is difficult to stabilize.second,high volume fraction ratio carbon nanotubes andTheaddition of graphene will greatly increase the viscosity of the mixture and suspension,This very small amount of carbon nanotubes can be added to the polymer matrix

.sofar,mechanical properties of carbon nano-resin matrix compositescan not be significantly improved,But conductive performance significantly improved,makes the aggregatetransition from insulator to conductor.Future carbon nanocomposites truetargetshould be multifunction[7576].Use conductive nano function in the thermal management and electronic device electromagnetic shielding ofahigh compact electronic systemComposite materials are very useful.

6.5 Environment friendly birth green composites,thermoplastic composite materialMaterial and efficient recycling technology

Green Composite refers to the use of degradable fibers such as natural fibresenhanced biodegradable biomass resins or degradable synthetic resins-New composite materials made from.Natural fiber reinforced composites with ringssecurity,Comfort,lightweight,attributes such as low price andrecyclable,Use natural fibresdimensional reinforced degradable resin new composites replace current resinsbase Composites,to reduce pollution,Protect Environment,for reply to the benefitLooming energy crisis and resource constraints,natural fibres and their compositesmaterial Yue gradually becomes an important direction of advanced composites research.

Advanced thermoplastic composites also have high performance,Lightweight andRecyclableProperties,with advanced thermoplastic composites on-line moldingTechnical Developments,application areas for thermoplastic composites will be furtherextend.also based onbiodegradation,Chemical decomposition etc compositesEfficient recycling technology will also be the development of resin matrix composites should bewith essentialtechnology.

6.6 Smart Composite Technology supportslarger,More integrated compositeThe reliable application of the material's overall structure

Advanced composite structural parts repair and disassembly more difficultDifficult,requiring more careful detection of key areas.structure HealthMonitoring provides a for overcoming the challenges faced by the composite structureOnemethods and opportunities.

Structural Health monitoring is the first in the development of composite material intelligence structures1Step.theStructural Health monitoring method reduces the amount of instrumentation required for the structurebetween.When the structure can be guaranteed to be detected before the damage is developed to catastrophic size,The designer also has confidence in the efficiency of the extended structure.Structural health monitoring will fiber sensor,Resistor sensor,piezoelectric sensorThe device is embedded in the composite and the structure to monitor the structure.

Smart by embedding sensors in composite structuresstructure faces the challenge of:robustness of aircraft life cycle,withDamage repair of sensor structures and information management of critical events.

6.7 "internet"ERA composites will face deep research methods

Carved change

Adramatic increase in information provides a richer research environment,at the same timealso raises a series of questions,There is a large number of data,WhatThedata for will be filteredout,What data needs to be stored,researcher

facesThe challenge is to ensure a comprehensive assessment of existing data and resources,withand new powerful sharing of data and impersonation.

Computer-controlled experiments allow experimenters to control via the Internetto experiment without having control next to the device.in this way,theExperimental device can be shared by all researchers,This allows the device to be daylightNight use to improve the current typical low usage efficiency,and will waitthe time required to obtain a dedicated device is used to redeploy further quicklyGet results.

Internetthe speed of social development in the era can be greatly improved,requiresto develop an understanding of composite research,First find informationthe correct location,re-develop and refine existing simulations and more precisemodel.

InternetAge composites researcher's education and training needsto specialize in a multidisciplinary task that is appropriate to assume,passblending of science and engineering,culture for multifunctional composites andBasic Skills for structure research.

7. closing

passesyears of development,Advanced resin matrix composites withHigh performance carbon fiber and aramid fiber have been implemented serialization and industry-*;mechanical properties of resin matrix composites,toughness,High temperature performance andProcess Comprehensive promotion;composite Component Automation,numberdown,integration and low cost manufacturing technologies tend to mature;to the lipid base compoundmaterial comprehensive review full,application areas and performance developmenthigh;structure features(suck/through Wave,anti-bullet,Thermal)Composite form BaseThis series,technology maturing.

Advanced resin matrix composites present major opportunities for developmentwith Challenge:resin matrix composites continue to develop in high-performance;knotrefactoronebody resin matrix composites present versatility and cutting-edgetrend;Composite design technology based on Multiscale modeling and characterizationthemost important development opportunity;versatility to future carbonThe important goal of Nano Composites development;Environment-friendly birth of greencomposite,thermoplastic composites and efficient recycling technology[;]Smart composite Technology supports greater, andmore integrated compositesReliable application of the overall structure; "internet"ERA composite faceThe profound changes in the approach to research.

References

1. Chen XiangTreasure.Polymer Matrix composites Handbook[M].Beijing:Chemical Industry publication Club,#:1-3.
CHENXB. Handbook of polymer matrix composites [M].Beijing:chemical industrypress,#:1.3 (Inchinese).
2. ChenShaojie.Composite technology with large aircraft[].Journal of Aviation,2008,(3):605-610.
CHEN SJ.Composite Technologyand Large aircra!t[j].Acta Aeronautica et astronautica sinica,2008,(3): 605-610 (in Chinese).
3. DuShanyi.Composites andAerospace[J].Journal of Composite Materials,2008,(1):1-7.
DU S Y. Composite materials and aerospace engineering[j].
Acta materiae compositae sinica,2008,1:1-7 (in Chinese)
4. LiuDaijun,ChenYali.Application of advanced resin matrix composites in aviation industry Material Engineering,2008 (supplement1): 194-198.
LIU D J,Ciien Y L.Application of Advanced Polymer Ma Trix Composites in aviation industry[j].Journal of Materials Engineering,2008 (SUPPL.1): 194-198 (in Chinese).
5. Luoyi,Luo.Recent developments in carbon fiber and its composites[].High
Science and technology fibers and applications,2014,1:1-9.
LUO Y F, LUOXM. New developments of recent carbon Ii.ber and their composite materials[j].Ili-tech Fiber&Ap.plication2014,(1):1.9 (in Chinese).
6. ChanXin,Emperor Static,ZhangYonggang,, and so on.ForeignPANCarbon Fiber research status andTrends[J].High-tech fibers and applications,,36 (3): 34-37.QIANX,HUANG J,ZHANG Y G,,*et al*.Present development trend of foreign PAN.based carbon Ii.bers<b127>[J].Iti-techfiber & Application,,,,(3): 34-37(inchinese)
7. RAO Y,waddon A J,Farris R J.The evolution of structure and properties in poly (P-phenylene tereph-thalamide) fibers[j].Polymer,2001,42 (13):5925-5935.

8. GabaraV,hartzler J D,LEE K S,*et al*. Handbook of fiber Chemistry-chapterl3:aramid fibers [M]. 3rd ed. Florida: CRCPress </b17>·2006·976-1026
9. machalaban N. Modern Para-Aramid Fibres.The role of Tver ' Khimvolokno Joint-stock Company in the creation of an AR-mos fibre plant[j].Fibre chemistry,1999,3:171-179.
10. abbronin I A,Rakitina V A,Gribanov V A,et
al. Quantum Chemical calculation of the character of Structur Alorganization and H-bond ENergy in the Benzimidazole R:AG-ment of fibres of Armos type[J]. Fibre chemistry,2002,
34 (2): 140-145.
11. SunYou-de,LiuQingbei.Russian heterocyclic aramid--Overview and development(_)[].
High-tech fibers and applications,,(1): 8-10.
SUN Y D,LIU Q B. Russia heterocylic copolyaramid-gen-eral Condition and Development (1) [J].Iti-tech Fiber & Application,,,(1): 8.(in Chinese).
12. SunYou-de,LiuQingbei.Russian poly ring Aramid-makesup(two)[].High-tech
Fiber and apply,,(2): 11-14.
SUN Y D,LIU Q B. Russia heterocylic copolyaramid-con-stitution (2) [J].Iti-tech Fiber&application,2,(): 11-14 (in Chinese).
13. ZhangWang,WangYanzhi.Performance and application of high performance inorganic fibers[].Synthetic fiber Dimension Industry,,2:38-40.
ZHANG WX,WANG Y Z. Properties and application of high-performance inorganic fiber [J].Fiber Industry,synthetic,2:38-40 (Inchinese).
14. JiangJianming, Li Guang,KimJun-hong, etc..Ultra High performancePBORecent research on fibers Progress[].Synthetic fiber,2008,1:5-7.
JIANG J M,LI G,JIN J H,*et al*.The latest devel opments of the super high performance PBO Iiber[j].Synthetic Fiberin-,2008,1:5-7 (Inchinese).
WangJiaming.PBOFiber Development and application prospects[].Petrochemical Technology and Economy,2009,2:26-31
WANG J M.The development and application prospect of PBO fiber [J].Technology&Economicsin petrochemicals, 2009,2:26-31 (Inchinese).
16. fan New Year,XuWei,Strict home policy,etc.HomemadePBOFiber Performance and morphology research investigate[J]CloseFiberDimensionworkIndustry,2013,(3) 12-15FANXN,XU W,YAN J C,*et al* morphology and proper ties of PBO fiber made inChina[j].Synthetic Fiber in-dustry,2013,(3): 12-15 (in Chinese).
17. ZhuHuijun,KimJun-hong,Liguang,, and so on.PBOPolymer and its fiber research into thetheshow[].Polymer materials science and engineering,2008,8:18-22.
ZHU H J,JIN J H,LI G,etal Development of Poly-benzoxazole Polymer and iiber[j].Polymer materialsscience&Engineering,2008,(8): 18-22 (in Chinese).
18. WOLFE J F. Rigid-rod polymer synthesis:development of mesophase polymerization in strong acid solution, in the"ma terials Science and Engineering of Rigid-rodPolymers [J].Ma terialsSociety Symposium Proceedings,1989,134:
83-93.
19. ZHU Y Q,ZHAO PC,CAI X D,*et al* synthesis and characterization of novel fluorinated polyimides derived from bis [4-(4</b17>·-aminophenoxy) phenl]-3»5-bis (trifluoro-methyl) phen yl phosphine oxide[j].Polymer,2007,3116-3124.
20. Liaw D J, FAN C L,LIN C,*et al*. Synthesis andCharac terization of new soluble poly (ester imide) s containing Nonco</b31>planar 2»2·dimethyl-4»4·-Biphenylene Unit[j].Journal of AppliedpolymerScience,,,(4): 2486-2493.
21. ZHANG J,FOX BL. Manufacturing influence on the Delam ination fracture behavior of the t800h/3900-2 Carbon fiber rein-forced polymer composites[j].Materials and manufacturing processes,2007,(6): 768-772.
22. niqamV,Setua D K. Morphology development during curing of epoxy-resin with liquid carboxy terminated Poly-BUTADIENE[J].Kautschuk Gummi Kunststoffe,2006,(6): 316-321.
23. TRIPATHI G, Srivastava D. Studies on the Physic-me chanical and thermal characteristics OF Blends of Dgeba EP-oxy,3,4 epoxy cyclohexylmethyl,34-epoxycylohexanecar-
boxylate and carboxyl terminated butadiene coacrylonitrile (CTBN) [J].MaterialsScience&Engineering,2008,1:483-493.
RATH S K,CHAV an J G,Sasane S.Two component silicone modified epoxy release coatings:Effect of modulus,Surface energy and surface restructuring on pseudobarnacle and maceofouling behavior [J].Applied SurfaceScience,
256 (8):2440-2446.