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Progress of cellulose-based Biomedical functional composites

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Abstract: cellulose-based Functional composites exhibit the functional characteristics, such as light, electric, magnetic functionsand catalytic properties, which have been widely applied in pulping and papermaking, fine chemical, tissue engineering, BIOmedical and other fields.cellulose-based biomedical composites are typical cellulose materials, combining the advantages of both biomass and biomaTerials, which have potential applications in bone repair and replacement, tissue engineering, drug delivery, Gene CarrieR, protein adsorption, and other fields.In this review, we introduced three synthetic methods to composites including hydrothermal (Solvothermal) method, MicrowAve method and ultrasonic method, discussed the advantages and disadvantages of these three kinds of preparation,reviewed the progress of cellulose-based materials, and systematically summarized cellulose-based biomedical compOsites such as Cellulose/hydroxyapatite, Cellulose/calcium carbonate, and Cellulose/ag composites.Based on our experience, we pointed out the problems and future development of cellulose-based BiomedicalItes.It is expected to provide reference for the resourceful, functional, high-value, and recycling applications of biomass.In the future, it is desired to develop the manufacturing strategy for large-scale synthesis of cellulose-basedComposites, explore its synthetic mechanism, and reveal the intrinsic relationship the among, cellulose functionalIALs, methods and properties.It is so known that cellulose is difficult to dissolve in water or organic solvents under normal conditions because of tHe intra-and inter-molecular hydrogen bonds.Therefore, the development of suitable solvent for dissolving of cellulose is ofMproving their industrial applications.

More recently, the cellulose Nanocrystal has received attentions to its due excellent.It is suggested this cellulose-based functional composites can be fabricated by using cellulose as matrix.Furthermore, rapid progresses are anticipated in the preparation of various-cellulose-based multifunctional composites including efficient antibacterial, flame retardant, waterproof, fireproof, adsorptive, anti-counterfeiting, RapidDetective and analytical functions.

Keywords: cellulose;composites;Functional composites;Biomedical applications;Preparation method

In recent years,with resources,The growing problem of energy and environmentaggravated,Conversion utilization of renewable biomass resources more and more heavy

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View^.Biomass resources mainly include agriculturalbiomass,Forestry Healthsubstances,,animal feces, and city garbage.China is an agriculturalgreat power,produces a lot of waste after annual crop harvest.thisoutside,,Our forest area is ranked fifth in the world,also richForestry biomass resources for$^{\circ 2}$.Agro-forestry biomass is made by the plant throughphotosynthesis generation,has a renewable and short regeneration period,andbiodegradation fea-tures.Agricultural andForestry Biomass Comprehensive development benefiton modern agriculture sustainable

Development,Our government in the medium and long term development

regulationsrow(2006-2020Year),willAgroforestry Projectcolumncoverage of major items conversion of agricultural and forestry biomass to gas,Liquid,solidEnergy and bio-base materials and chemicals areas.

Agricultural and forestry biomass mainly by cellulose,hemicellulose and ligninmake up,three to total content90%above[3].Take advantageof modern science and technology to effectively separate and transform agricultural and forestry biomass components,to get new powder material,film material,Gel Material,Semiconductormaterials and biomaterials a series of high value-added products[4].fiberWisue is nature's richest natural renewable polysaccharide,hassource wide,cheap,can regenerate,can degrade,non-toxic,to deriveattributes,is one of the important biomass materials.based on celluloseComposite material can be widely used in textile,catalysis,Food Packageinstall,Bio medical,areas such as water treatment^.cellulose converts to workEnergy composites,facilitates new approaches to agricultural and forestry biomass utilization,is of great significance to the realization of economic sustainable development.

composite material refers to a physical or chemical method,adds twoor two or more different properties of a material with new performancematerial.thecomposites prepared by the will not only keep the original single component of thesection properties,and because of the interaction between the components, you can also maketheimproves overall performance,and get the original componentsex,:Composite effect.recent,Cellulose-based functionalityTheComposite material research is widely watched.In this paper, I introducethethe The composite Water hot(solvent Hot)Method,Microwave-assisted and ultra-Sonic etc3Seed Preparation Method,A brief review of the Cellulose feature complexMaterials development process,focus on cellulose based biomedical complexThe latest research progress of materials,Finally, with the author's own experience,discussesThe development direction of cellulose based biomedical composites,withThe resource of biomass material represented by cellulose,feature,High-value and circular utilization provide references.

1. method for preparing composite materials

Composite Preparation methods many,such ascoprecipitation,Blendsmethod,Template method,vapor deposition and biomimetic mineralization[6_7].These methods are featured,widely used incomposite material Preparation,Thegreatly facilitates the development of composite materials.This will focus onThe hot water used in the preparation of cellulose functional composites(solvent hot)Law,features of microwave-assisted and ultrasonic methods and

Limitations.

1.1 water Hot(solvent Hot)Method

Thehydrothermal method refers to a closed container in which,use water as a solvent,chemistry by heating and pressurizing the reaction systemresponse.in accordance with the reaction temperature hydrothermal method can be divided into sub-critical and super-Critical response two kinds of,where the temperature range of the subcritical hydrothermal reaction is100~240°C,and supercritical water temperature up to1000°C,pressureup to0.3GPa.in hydrothermal reaction,water can be used as aChemical component participation in reaction,can also be used as solvent or extruded to promoteagent,also available as pressure transfer media[8].using hydrothermal methodtheComposite has many advantages,For example, you can significantly reduce the reaction temperaturedegree,to prepare high crystallinity,High Purity,Good dispersion,Uniform size,no-Reunion and shape-controllable composites.thesolvent thermal method isdeveloped on the basis ofthe water thermal Law,Thediffers from hydrothermal method in that it issolvents are organic rather than water.under solvent heat conditions,Products subjecttoThe effect of solvent properties is greater,including solvent density,viscosity and divideScatter action.

1.2 Microwave-assisted method

fromcenturyMid-term researchersawill be microWave heating technology introduced into a liquid chemical reaction.,Microwave heatingTechapplication in chemical reaction and material preparation got a quickShow

Buall.Microwave is a frequency range in0.3~300GHzthe electromagneticwaves,Microwave Heating is coordinated by the interaction of intermolecular dipole momentsHigh frequency electromagnetic radiation implementation,With body heating,heating fast,Advantages of low heat loss,so it can greatly shorten the reaction time.ikjimaetc°^heating by microwave2minto produce a pingmean particle size less thantennma~Fe_2O_3nanoparticles.Research sendnow,Heating with microwave,a~Fe203quick Form,even extendedheating time to1h,also has no by-products such asa~Feooh, and so on,into;with traditional heating1Hgeta~Fe203andA^feoohmixture.Traditional hydrothermal methods generally require heating for several hours evenafew days,compared to traditional heating,Microwave Hydrothermal method has reaction conversionrate High,reaction time Short(only a few minutes to a few 10 minutes)to),Save energy and green features[M].

1.3 Ultrasonic Method

The ultrasound is a frequency higher thankHzSonic for,hasdirectional good,Strong penetration features.Ultrasonic synthesis is the use of the dissolvein the liquid continuous formation,bubbles created by the growth and instantaneous rupture of theair effect,causes the solution to produce a transient high temperature in a local location(>5K)/high-pressure(>1MPa)and extremely fast heating,Cooling rate(>1010K/s),toDrive chemical reactions[Q4--15].These bubbles in diameters up to several microns at the moment of rupture thelocaleffects can cause physical and chemical changes in the media,generating machineWeapon,hot Chemical effect°^.Use the cavitation effect of ultrasound toCreate a single scatter with adjustable performanceFe;O4/Si02core shell structurenano composites[M].in my previous research work,passOver-system comparison microwave method,Ultrasonic method and traditional oil bath heating systemPrepare cellulose/CaC03Composite Discovery,with microwave or oil bathheating comparedto,Ultrasonic method is more advantageous to the preparation of dimensional uniformity,,consistentand pure composite material[Q7]_#.

2. The rise of cellulose matrix composites

Cellulose is an important biological material,Superior Performance,Applybroad.however,Cellulose also exists as not resistant to chemical corrosion,intensityLimited Not enough,restricts its application.combinecellulose with itsHis organic or inorganic materials in combination with the compositematerial,can not onlyPreserve Cellulose's original performance,also give it new performance,""Land extension applications of cellulose.In recent years,cellulose featurescomposites are widely watched,because of their goodbiocompatibilitysex,biodegradability,Low-toxicity,Magnetic/Optical/Mechanical Properties,inFiber,catalysis,Textile,Water Treatment,fields such as biomedical havePotential application Prospects[^9]-.

Themolecular chain of cellulose contains a large number ofOH,can passElectrostatic interaction adsorption metal ions, then in-situ restoreThe method of is to prepare a cellulose-funded nano-composite material.early in2003year,Heetc[122]Using porous cellulose as a nano-reactorprepared by in-situ synthesisAg,Au,PtandPdNanogranule.Wangwait[023]Poly (ethylamine) as reductant and cross-linking agentPrepare bacterial cellulose/AuNano-composites,and the composite materialmaterial for immobilized horseradish peroxidase preparationH2O2Bio-sensing,,todetect concentrations below1pmol/LH_2O_2.Jiangetc[M]Agnanoparticles in situ deposited on cotton fabric with acotton fabric with antibacterial properties,The prepared cotton fabric has excellent resistancebacteria performance and washable performance,onpage after wash to largeThe killing rate of Enterococcus and Staphylococcus aureus still reached the98.5%and94.3%.addition,Cellulose can also be withCu,Pd,CoandNietc Metal Composite prepared with excellent antibacterial properties,catalytic performanceandMagnetic properties of composites[02548].

cellulose can also be used with oxides such asFe203,Ti02,ZnO,CuO,M%04Composite preparation of cellulose functional composite materialmaterial[0]?-?.For example,|-8etc[l]to ionic liquid[bmim]Clto solvent,Using Coprecipitation method in-situ synthetic fiber/7~"Fe2"03nano composites,The composite has Super paramagnetic,on plusThehas a keen magnetic response under the magnetic field.withpUn)and Submethyl blue(MB)for model contaminants Research composite adsorptionPerformance Discovery,its toPb(N)and,mbadsorption capacity,5and5mg/g,Using the magnetic properties of the material in the external magnetic field forthe To effectivelyrecycle the material.^^etc[030]Use

BambooCellulose as template to produce a millimeter-length,diameter aboutnm"anatase"ti02fiber,This material has excellent light remindersperformance,can effectively decompose benzene under ultraviolet irradiation.Asirietc[033]Research Cellulose/M%04composite to includeCu^{Hydrate},Cd^{2}+,$C0^{2}$+,Cr^{3}+,Fe^{3}+,Ni^{2+},Zn^{2}+andZr^{4}+a series ofadsorption properties of heavy metal ions discovery,the composite to theCr^{3+}shows strong selective adsorption performance,Its adsorption capability is0mg/G,adsorption capacity of other metal ions size order for$Zn^{Hydrate}$>Fe^{3+}>$Cd^{Hydrate}$>Zr^{4+}>$Ni^{Hydrate}$>$C0^{Hydrate}$>$Cu^{Hydrate}$.

cellulose can also be associated with metal sulfide(such asCdS,PbS,ZnS, and so on)Composite preparation of cellulose matrix composites[B4_37].early inyear years,Ruanetc[034]toNaOH/urea to cellulose solvent,usingThe In-place compositing method to prepare theCdS/regenerated cellulose compositesMaterialThe material produced by the,,shows a narrower photoluminescence emissionwith.["]and so on. With different apertureCdS/regenerated fibersCatalytic performance of Wisue nanocomposite films under visible illumination,withCdSnanoparticles comparedto,preparedCdS/regenerated Cellulose nano-compositefilm with better photolysis hydrogen performance,Persistent light tolerance and can beNature.thongtemwait[036]withPb(NO3)2and AminoThiourearaw material,with carboxymethyl cellulose as template,prepared by hydrothermal methodto carboxymethyl cellulose/PbSComposite.by changing the carboxyl methylcellulose,NaOHAdd amount and hydrothermal reaction temperature can be preparedout of different shapes(like a flower,nanoparticles,Tubular)forCdSmicro-nameter structure.

also,cellulose can also be combined with a variety of metal or inorganic materialsComposite preparation of multiple composite materials.such as nanometer cellulose can alsobeprepared as a template and a reductant whenFe304/Ag//nanometer celluloseternary composites,and the material to the4^Shaw Bon has excellent-heterogeneous catalytic restore performance,Recycle7times to4^The transformation of Shaw benzenetherate can still be reached81.8%.addition,prepared materials to goldenStaphylococcus aureus has strong antibacterial activity, is expectedtobea loop to makeuse catalysts and antimicrobial agents for pharmaceutical or environmental applications[020].Sunetc[038]use bacterial cellulose as a template,withKBH4to restoreagent,from containingPdCl2andCuCl2in aqueous solutionofPd-Cu/Bacterial cellulose composites,the composites prepared by can be used asWater denitrification Catalyst.Liuetc[3]using carboxyl carboxylic nanofibersWisue for brackets,NaBH4is a reducing agent,Toprepare theAg-MAlloy/carboxyl-cellulosenanocomposites,They think the scaffold usedisThecarboxyl and hydroxyl groups in the material of the are adsorbed on metal cations andag-pdAlloy nanoparticles with synergistic action,co-promote nanometeraggregation of particles.

3. development of cellulose based biomedical composites

In recent years,cellulose and inorganic materials(such as$Ca_5(PO_4)_3$(-OH),CaC03,CaSi03,AG/AGCLetc)Composite biologicalThemedical composites are widely watched.For example,Fangetc[M]The process of biomimetic mineralizationHA/Bacterial cellulose nanocompositematerial,and using stromal cells of human bone marrow cells as model,researchThe proliferation of bone marrow stromal cells and the differentiation ofosteoblasts by materialsaffect.Research findings,inoculated against matrix cells of compositescells with pure bacterial cellulose have better adhesion and activitysex.Dagger^etc[41]also synthesized bacteria by biological mineralizationcellulose/Ag/AgClNano-composites,The material is on the agar plateand liquid culture medium for Staphylococcus aureus and Escherichia coliHas a strong antibacterial effect.addition,Liuetc[%via protein trapPreparation of new bacterial cellulose by guided-in-situ biomimetic mineralization/CaC03Composite,CaC03has a slice structure,Complex prepared bycomposite material with rough surface and porosity adjustable complex three-dimensionalStructure.in the early work of the writer's team,through water hot,Microwave,Ultrasonic methods Prepare cellulose/HA,cellulose/CaC03and cellulose/CaSi03Aseries of nanocomposites,and preliminaryToExplore its biological performance[+_.

synthesis of cellulose and inorganic materials into composites,apply to protein adsorption,Organization works,Antibacterial medical collardomain.using cellulose as a matrix material has many advantages:based onstructural

characteristics of a cellulose macromolecular chain,make it strongand interaction performance,Therefore, the cost of this class of materials is low,working workerArt is simpler;cellulose itself has good biocompatibility and healthobject biodegradability,so_Environment-friendly materials;relative toHighpolymer materials such as collagen,cellulose has excellent mechanicalcan,It can effectively overcome the lack of mechanical properties of polymers such as collagendefect.The cellulose material used for such materials is widely available,low priceCheap and green environment,low production cost and good biological activitysex,Therefore, the development and application of biomedical fields will have a goodSocial and economic benefit for.

3.1 Cellulose/Hydroxyapatitenanocomposites

Lightweight base disc Ash(hydroxyapatite,HA)often with non-chemicalmetering ratio,substitution of ions or absence of calcium exists in vertebrate vertebratesskeleton,in hard tissue such as teeth,and give these hard organizations the necessarymechanical Properties(if intensity,Hardness,toughness and stability),andwhenHAalso many calcium phosphate salts are most stable under physiological conditionsCrystal phase.SyntheticHAdue to its good biological activitysex,biodegradable and bone conduction,widely used in bone repairand bone replacement organization engineering fields,gene transfection and drugs/eggsBai fields.however,asFirstBiological material,manual closetoHAalso has many flaws,For example, flexural strength and fracture toughness notenough to limit its application.bones or other calcified tissue can seeasa kind of biological minerals(_or a variety of calcium phosphate salts,occupies skeletontotal(65%~70%)Natural anisotropy of embedded protein matrixheterosexual composites,It also contains other organics and water.point".researchers are inspired bythe,todevelop a seriesofpolymer for matrix materialsHApolymer Compositesmaterial, toimprove their mechanical and biological properties.where,fiberWisue because of its excellent mechanical properties,Goodbiocompatibility,,derivative and inexpensive, and other features that have been widely watched.

In recent years,Researchersare using cellulose(or its derivationobjects)as matrix,prepare cellulose by different methods/HACompositematerials used in biomedical fields doing a lot of research[B2]_,,.examplelikeRodriguezwaitconvertelectrospinning cellulose acetate to acetone/n,(/)[* * * * [] ()-two methyl acetamide,and thenNaOH/ethanol saponification notToprepare regenerated cellulose brackets at the same time.pretreatment ofregenerated fibersdimensionbrackets with different reagents,such asCaCl2,carboxy methyl cellulose and$CaCl_2$,NaOHandCaCl2,and then soak in theSimulate body fluid inductionHAon its surface nucleation and growth,preparedHAmineralized regenerated Cellulose scaffold material can be applied to bone repairRealm.ramanietc$Preparation of oxidized stone by chemical precipitation methodGraphene/HA(go~HA)composite,Then and bacterial cellulose(BC)Composite Preparationgo-HA~BCThree-phase composite bracket material,ResearchFind outgo-HAevenly adsorbed on theBCSurface.willgo-HA-BCbracket andMG-53cell andNIH-3T3cell co-culturenow,preparedGo-HA-BCThe stent has good bone-inducing abilityForce andbiocompatibility.Parketc[B7]takeTEMPO/nabr/naclooxidation system toBCSelective oxidation,get surfacenegatively oxidized bacterial cellulose(TOBC).throughHAnanoThe hydrogen bonds between the hydroxyl groups on theparticle surface andthe carboxyl groups inTOBCareused aswith makeHAandTOBCtogetHA-TOBCCompositematerial,The prepared composite can be well dispersed in deionized watertoform colloidalsolutions (diagram1.toHA-TOBCcolloidalsolutionsaddgelatin(Gel)and cross-linking agent Glutaraldehyde,can be preparedHA-TOBC-Gelcompositehydrogels.will prepare the porousHA-TOBC-Gelcombined hydrogel with skull osteoblast cell culture hairnow,The composite hydrogel can effectively improve cell proliferation and division of the cells to.La_netc[:use electrospinning to prepare nuclear-sheath knotstructuredtri-acetic acid nano cellulose(CTA,kernel)/ha(scabbard)Compositefiber,and prepare theCTA~HAComposite fiber for bovine hemoglobinwhite(Hb)adsorption.thisCTA~HAcomposite Fiber toHbshowGood adsorption performance,Its maximum adsorption capacity is176.mg/G,ismuch higher thanCTAnanofibers$mg/g.

in the previous research workof the author,with Lignocelluloseto Matrix,through hydrothermal method inNaOH/Urea Solution Preparation Fiberdimension/with carbonateHAnanocomposites[$];withN,N-two methyl

acetamide as solvent,using microwave rapid heating technology to prepareCellulose/HANano composites[M];by means of a microwave hydrothermal methodprepare surface porous wood fibers/HANano-compositematerial?.also,withNaOH/urea to solvent,with phosphorus biological Divisionchild(three adenosine phosphate,Creatine phosphate and twodiphosphate)is a phosphor source,Rapid preparation of cellulose using microwave hydrothermal method/HAnanometer composite material

MaterialAll.by changing the phosphor source,Microwave heating time and temperature,canimplement to cellulose/HAMinerals crystals in nanocompositesphase,,resizing and topography control,To obtain the different appearance of theHANano-structure.

3.2 Cellulose/Calcium carbonate nanocomposites

Calcium carbonate(CaC03)not only widely available in marble,limerock,chalk Rocks inside,alsovertebrate bones and teeth,Coral,eggshell,Pearl,"Sea urchin thorn and exoskeleton of crustacean"Main inorganic composition.addition,CaC03is also a source rich,cheapcolorGood Universal filler,widely used paint,plasticMaterial and paper industry.naturalCaC03with3species anhydrous crystallizationphase,: Calcite,aragonite and Balloons,at room temperature and atmosphere environment BarThe thermodynamic stability of calcite is highest,and the marble is metastablephaseCaC03,Lowest thermodynamic stability,There are also two other types ofThe water phase and an amorphous phaseCaC03.other than industrial applications,CaC03isalso widely used in the study of the mineralization of organisms,andandCaC03has good biological activity,protein stickiness,Finecell compatibility,Hard organization compatibility,Isalso widely used in medical fieldswide application foreground.

In recent years,base on cellulose,CaC03is an enhancement phaseprepared cellulose/CaC03Composites are also concerned about,made byPrepare cellulose/CaC03Composite can be used not only as a paper enhancementagent or adsorbent[60–62],and in the biomedical field also has the unspokenin application foreground.For example,

(BC)membrane soak in containing$CaCl_2$,glycine,$Na_2C03$and mesoporouscorner fork Glue(Carr)solution,using colloidal crystallization process to prepareshowBC/Carr^CaC03Composite Film,and uses the prepared composite film for theload anticancer drug doxorubicin(doxorubicin,Dox).The fluorescence microscope photos that follow the drug can be observed in the,DoxinBCFilmabove evenly dispersed(2a);willBCThe film is soaked in theCarrafterReloadDrugsDoxwhen,becauseof theCarrThe existence of can be from the diagramobserve some fluorescent spots(*2b);diagram2cThe also observes a similarbehavior,but becauseofCaCO3The presence of,causes the mount to be mounted on theBCFilmDoxless;whenBCin the membraneCanandCaCO3,Doxismainly loaded in spots(diagram2d).ir,confocaland SEM analysis results show that,takeBC/Carr^CaC03Complexfilm loading drugs,Doxmainly wrapped inCarr^CaCO;ComplexBalloons,Doxload rate is approximately80%,and showPHRingsSexual release performance.on37°CConditions will bepHfrom7.4To5.8when,The amount released from the1.50Snooze/Dto1.70Snooze/D.

a) BC;b)Bc-carr (c) BC-CAC0_3;D)bc/carr-cac0_3

diagram2loading of different bacterial cellulose membranesDoxafter

fluorescence microscope photos[All

Fig.2confocal microscopy images of different BC

Membranes loaded with Dox[

Liu, and so on[studyon polyacrylic acid(PAA)Existing conditionsCondition,CaCO3in electrospinning cellulose acetate(CA)on minebehavior.fromSEMphotos can be observed,PAAtocacogThe nucleation and growth of crystals have important effects.,Add and do not joinPAAgetsCaCO3has significant differences in appearance(diagram3).When the solution does not containPAAwhen,revenueCaCO3for Ling body Square solutionstone,and can observe someCAfiber embedded in calcite(Chart3a,).whenCaCl2solution containsPAAwhen,Fiber surface changeRough,andCAFiber surface formed by nano-needle polymerization$CaCO_3$coating completelycovered(diagram3C,).from the diagram3cZoominChart to observe,CaCO3wrappedCAfibre diameter1~2$CaCO_3$coating thickness is approximatelynm.onPAAexisting barsunder,formCaCO3coating does not affectCAFiber Original

Form,and can be removed by dissolving the with acetoneCAFiberVictoria,get calciteCaC03micron Tube.

Good biocompatibility,Biodegradable and non-toxic specialPoint,and cellulose surface oneOHtoform a molecule,intermolecular hydrogenKey mesh structure effective controlAgnpsgrow to implementAgnpsRegulation of shapes and sizes.cellulose structure containsmass oneOH,make it negatively charged in aqueous solution,To metalions have adsorption performance.addition,reduction of cellulose molecular chainThe end base can also be used as a reductant for metal ions.so,cellulosecan be bothAgnps's matrix,Stabilizers and/orAg^{+}cl-Restore Agent[,,Thecellulose that is prepared by the/agnanocomposites can befor textile,medical,Food packaging,Water Treatment and many other fields.

in the previous work of the author team,the studied ultrasonic methods andMicrowave method in preparing cellulose/CaC03Composite toCaC03Effects of crystals[from.Research Discovery,method of preparation forCaC03CrystalBody's object,micro-structure,appearance,,thermal stability and biological activityhas influence.For example, ultrasonic method can be used to get the size of the""~nmThe pure Ball of the Opal microspheres,and using the microwave law to getsize is0.~1.|XMcalcite and spheroidal aragonite ofCaC03.also,author with ionic liquid[bmim]ClSimultaneoussolvent and microwave absorbent for cellulose,Fast heating by microwavetechnology Preparing cellulose/CaC03Nano-composites,and by changingvariable cellulose concentration can be produced with polyhedron or cube structureCaC03Crystal[43].to prepare composite material with human gastric cancer finecell(SGC-7901)TonurtureAllHafter,Most cells are stillmaintain normal spindle shape,prepared cellulose/CaC03complex, composite materials with good cell compatibility,in biomedical domain withhas potential application value.

3.3 Cellulose/Silver Antimicrobial materials

Many antibacterial materials can kill harmful bacteria in the body invitro,including metal oxides(likeZnO,TiO_2,CuOetc, metalvulcanizationObjects,halide,and Precious metalsAg,Pd,Au,Pt, and so on.in theseAntibacterial materials,Metallic silver nanoparticles(Silvernanoparticles,Agnps)has a larger surface area,Excellent antibacterial performance andNo harm to human cells,Thus considered the most promisingantibacterial material.has so far discovered silver and its compounds to650multipleBacteria Exhibit good antimicrobial activity.Cellulose has a

diagram4Cellulose solution to regenerated cellulose sponge and cellulose/agComposite Sponge(on),Cellulosehydrogel,composite hydrogels and cellulose/ag structure diagram of the sponge(under)[67

Fig.4Photographs of cellulose solution to the Construction of regenerated cellulose sponge and Cellulose/nanosilver composite Sponges (top), and Schematic architecture of the cellulose hydrogel as Hydrogel and sponge (bottom)[Composite

Sureshkumar, and so on$to prepare the using a high-pressure homogeneous methodout of magnetismBCnano fiber,and then magneticBCnano Fiber leachingbubble in dopamine solution,through the self-polymerization of dopamine intheBCsurface Generation poly-Dopamine layer.last soak inagnogsolutionin,using poly-Dopamine toAg^{+}restorein situ synthetic magnetismBc/agNano-composites.Composite materials prepared by the for large intestine barsbacteriaand Bacillus subtilis have high antimicrobial activity,to be freshLBIncubation of medium and material4Hno visible fine found afterBacterial Infection.so,This magneticBc/agnanocomposites can also beforsterilization of fermentation medium,and you can pass the external magnetic fieldThe effect reclaims or removes material.recent,Yeetc[toNaOH/urea to solvent,Epichlorohydrinis prepared by crosslinking agentWisu gel,then get the fiber by water heat and freeze dry treatmentelement/agSponge material(Chart4).Antimicrobial Research results show that,,,The sponge is excellent for both Staphylococcus aureus and Escherichia coli. Antibacterial

Properties,thediameter of the bacteriostatic rings is, respectively.5~.8mmand 4~no.6mm.Body test results found,This sponge canAccelerate the healing of infected wounds.porous structure of cellulose spongeallowsufficient air topenetrate,Thesponge can effectively adsorb the injurymouth exudate,and SpongeBobAgnpscan effectively kill harmfulbacteria,therefore prepared cellulose/Agsponge can be used as a wound dressingfor wound healing.

in the author's earlier work,using synthetic cellulose as a

AgnpsThe matrix of the andAg^{+}The reductant of the ion,through hydrothermal methodaStep synthetic cellulose/AgNano composites[all.preparation for complex-MaterialsAgnpshas a spherical structure,through control reaction baritem,can produce different sizes of synthetic cellulose/AgNano-compositematerial(#5).composite for Staphylococcus aureus and large intestineAll Bacilli Show high antimicrobial activity,its bacteriostatic ring sizerespectively?0~0mmand7.5~0mm.

There is a literature report on the cellulose matrixAgnpssterilization mechanismto:bacterial surface usually negatively charged,Agnpscan be done by static,With the surface attached to the bacterial membrane,block cell permeability andbreathing function;AgnpsTorelease theAg^{+}Ion,Ag^{+}ions can penetratecell membrane into bacteria,and with bacterial cell wall and cytoplasm containingS,PEffects of compounds,affect cell infiltration and division,causesbacterial deaths[69;Ag^{+}ion penetration into bacteria,andDNAsulfhydryl protein,makeDNAdeform to inhibit bacterial multiplicationcolonization,and eventually causing bacterial death[A].cellulose macromolecules chainwith have a lot of oneOH,These oneOHCan not only be absorbed by electrostatic action withAg^{+}Ion,can also form a numerator,intermolecular hydrogen bonding mesh knotconstruct,AgnpsTheis bound in a cellulose mesh structure,TocontroltheAg+ion release, toAchieve continuous antibacterial effect.

4. Epilogue

is currently,Cellulose functional composites inpulping and papermaking,FineChemical,widely used in areas such as food packaging.fully,Cellulose based biomedical composites combined with cellulose materialsand biomaterials benefits,in the organization project,Biomedical,gene DownloadThe potential application value of the body and protein adsorption.In recent years,Agriculture and forestry biomass resource,functional,high value and followRing utilization as an important direction of research,Cellulose functional compositesespecially cellulose based biomedical composites must be tightly aroundThese research directions,guided by major national requirements,face the WorldTech Frontier,address bottlenecks restricting industry development,for it shouldwith new ways,providing new ideas.Future research,exceptcontinue cellulose esterification,etherification Traditional modification,expands its combinationoutside of method and material type, itis necessary to explore the appropriate industry

GeneralPreparation strategies for production,Tostudy its synthesis mechanism,revealsIts composite effect,Clear Preparation method,Performance and mechanism betweenorganicrelationships,Integrating cellulose based biomedical compositesmethod,material,mechanism,Performance and apply,for cellulose featuresThe industrial application of composite materials provides theoretical basis and experimental basis.Cellulose-represented biomass,Performance stability,hard to dissolve inGeneral Solvents,looking for the right solvent is the prerequisite for application.nanometer fiberWisue with outstanding performance wide attention,recommends that the fiberTheelement type selection is also appropriately nano-cellulose,thefeatures and benefits of are applied to functional composites.base,Multi-functional composites in cellulose are important in the field of biomassDevelopment Direction,recommended new highly efficient antibacterial,fire-Retardant,suckWith,waterproof,Refractory,Security,Fast analysis and detection with the multi-function

specialComposite material.with cellulose functional material as precursor,can gotocarbon-based Functional Materials,apply to environment repair,soil improvement withand supercapacitor fields.cellulose hydrogel can be appliedtoa wearable strain sensor for health monitoring whenreal,Design Integration to guidepower,high elasticity,Self-healing and contingency-sensitive softWater gel sensors are expected to make new breakthroughs.

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