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Graphene oxide composite Research Status and Progress

Current situation and Progress of graphene oxide composites

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Abstract: Graphite oxide (Gnpheneoxdego) with its unique two-dimensional nanometer layer structure , Super large surface area and hydrophilic polar interface , make it function The field of composite materials has wide application and development prospects . This article summarizes recent years go Composites in enhancedtoughening , Adsorption separation , photocatalysis and Biomedicine Research Status and Progress , introduced go regulating the formation of structured and orderly microstructure of polymeric materials and cement matrix produces significant enhancement The mechanism of the toughness , Analysis go composites on adsorption , catalysis , the principles of biomedicine, etc. , indicates that go Enhanced toughened composites ,,go adsorption complex Composite and go application prospect and development trend of photocatalytic composite materials .

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Graphene oxide (grapheneoxide , Go) is to oxidize graphite after ultrasonic peel , Scatter , pieces of layered material after smashing , from the Chemical structure See go is graphene oxidation product , with graphene is the same as its structural unit has the C atom six yuan ring structure , has a hydrophilic group on a lamellar structure different from graphene , as carboxyl , hydroxyl group and epoxy group , easily disperse into stable nano in aqueous phase layer dispersions ,go Aggregation in the dispersion go is from different pieces The layer consists of a , and the number of slices and go The preparation process for the and the scatter bars are related to, the has a significant impact on the application of Go . current ,go Use mainly has :(1) Preparation of reduced graphite oxide (reductionof

grapheneoxide , RGO). through go with reductive chemistry Reagents such as hydrazine hydrate , phenyl hydrazine , ascorbic acid , Gallic acid , Sodium borohydride etc [1-11]reaction to prepare RGO, Use RGO wide range of battery power Polar material , Super Capacitor , Biosensors , fields of Catalyst components ; (2) To prepare adsorbed materials. go has good adsorption performance , compound and chemical modification of chemical materials by using the _ [A -/ etc reaction , on go upper graft specific adsorption chemical group , improve adsorption selectivity and effect ;(3) Preparing composites . go with organics and inorganic materials through in-place aggregation , Physical blending methods preparing composites , significantly improve the material material strength and toughness performance [1819] . because of the "Go" slice layer

structure Status , use directly Go is greatly restricted , is currently Go The main purpose of is to prepare composite materials , where enhanced toughened composites ,adsorption composites and their composite with catalysis , protein Repair The material became the hotspot for research . This article summarizes the adoption of the go system Preparation Enhancements , adsorption , photocatalytic degradation of functional composite materials Progress , looks at Go in

composite application foreground .

1. Go / Research Progress on polymer composites

1.1 Go / Poly L - lactate (PLLA) Base Composite

Go has a nanometer layer structure , its size can control , and

with a carboxyl on the slice layer , Hydroxyl chemical groups , in the ability to form crystals Environment ,go The participation can regulate and change the shape of crystals and the aggregation mode , to improve thermal stability and mechanical properties of materials . research investigate show , L- polylactic acid (Poly (L-lactic Acid), PLLA) existmechanical Performance Difference , Low crystallization rate , slow degradation rate and biocompatibility Bad issues [23-] . go nanometer slice layer can control poly PLLAcrystallization behavior , make it form orderly , petal-shaped crystals evenly distributed (Chart 1) , significantly improves PLLA heat and mechanical properties [a] .

1.2 Go / Poly s - lactone (PCL) Base composite

RGO is Go The obtained by the reductant , is oxygen content Lower go . , Wang etc [] studied RGO and go Clustering e -

lactone (Poly (e-caprolactone), PCL) microstructure and performance effect , The results indicate that , is mixed with RGO and Go microscopic of the polymers of regular crystals appear in the structure (2), its yield stress and yang has approximately 24% Promotion , Go than RGO Enhanced toughening of The effect is more pronounced .

1.3 Go / Glass fiber matrix composites

Ning , and so on [%] discusses glass fiber , Amino Modified glass fiber and using go modified glass fiber microstructure and performance , The results indicate that , Go The introduction of the enables the semi crystalline polymers of the fiberglass to be at the interface of the crystallization performance significantly increased , the Mechanical properties of the materials are also obtained big promotion . so ,go Can be used in glass fiber matrix composites enhanced and toughened .

1.4 Cement / Go Composites

Go Nano-layer for the shape and aggregation of cement hydration products

structure and performance have significant controls . Lu Senhua wait [all] Research go nano layer admixture to cement quality 0%~ 0. 06% , Water microstructure and mechanical properties of cement-based composites (table) 1),, results to show , add Go The mechanical properties of the cement sample after have been significantlyimprove .

is mixed with Go Cement base of SEM The shape is shown in **Figure 3** shows ™ . results show , not adding go The cement matrix of the has rods and sheets Crystal , But its aggregation method renders a cluttered stack , existing Lots of gaps and holes . mixed into a cement matrix with Go is formed from the bar , Floral and polyhedron crystalline structured aggregates ,, find crystals in loose parts of structure and pores , hole section bit more , The growth process fixes these structural flaws , makes the The structure of cement-based composites is homogeneous and compacted . , to Improve water Mechanical properties of clay materials .

Lu Senhua [], [] studied Go " layer oxygen content to cement " Effects of crystallization and properties of the products , results show , with Oxygen increase , Increased number of regular crystals formed in cement matrix , and mechanical performance is also on the rise (Chart 4). go layer Oxygen content
is 9 . 31% , to form a regular flower structure , Small size , quantity is greater than less , unevenly distributed , increased mechanical performance in 20% around ; OxygenContent on ? 43% , The volume of the flower crystal becomes larger , An increase in the number of , distributes evenly , Mechanical Performance improvement rate up to 30% Oxygen content is to 78% when Shape

To polyhedron structure , Large Size , more than , High compressive strength . Its growth procedure , results show , maintenance 1 days more micro-spherical crystals

Lu Senhua [], [] by observing the Go mixed with 0. 03% (No) (no) () () () () The body grows out of, maintenance 3 Diva grows into a stick-shaped crystal. , maintenance 7 Dayssame time cement hydration matrix SEM appearance (diagram 5) , the analyzes has a flower crystal assembled by a rod Crystal , Maintenance Day days

large-volume flower crystal , Maintenance Day flower crystals form with dense clustered crystals ,9 0 Day flower crystals through each other through the , , cross to form a more dense cross-linked structure . These hydration crystals of the growth formed a cross- linked , dense microstructure , Improved cement base The volume stability and mechanical properties of the material .

On the basis of the above analysis , Lv , and so on _ raises the Go regulates water

The mechanism of slurry crystallization (diagram 6). first , live in cement base Sexual composition and Go Active group action on , to form the growing point of crystals , to attract active ingredients from cement-based materials continue to react to form a rod Crystal , clustered in _ hole in cement matrix , crack place split flower Crystal . go nanometer sheet layer in cement hydration crystals The process of formation plays the role of template and assembly .

Fakhim Topic Group [1] mixed with 0. 1%~2. 0% for Go , prepared with Go ^ Cement Composite . found in go blending to Cement amount 1. 5% , The tensile strength of cement-based materials increases by 48%. through SEM detect , found a needle crystal in the cement matrix body enclaves and lamellar crystal enclaves , presence of crystal enclaves description go regulating the shape of cement hydration products , also indicates that go Uneven distribution in the cement matrix . makes a certain amount of to go nanometer layer evenly dispersed in cement matrix , its microscopic The structure also presents a structured order , uniform microstructure , Mechanics can improve a lot, description go The dispersion of the nano-slice is the key factor .

2. Go The progress of the composite adsorbent materials

Go The layer has a large surface area , Has a carboxyl on the surface , hydroxy base , epoxy Group [+] , makes the Go has exceptionally excellent adsorption performance,go has important applications in adsorbed materials [3-6].

2.1 Go progress in magnetic composite adsorbent materials

The magnetic properties of the composite are mainly magnetic Fe 3 O 4 particle , make it easy to recycle when regenerating with magnetism , improve adsorption material The number of times it is used . Zhang Yi etc [Panax] prepared by pyrolysis method to diameter nm around Fe3O4 nanoparticles , after complex surface modifier withgo Get magnetic composite , saturation magnetic field intensity up 41.3A • m^2 • kg -\ Fan etc [8] prepared structural stability , can repeating magnetic chitosan /go Composite ,is easy to regenerate

Shortcut Features , for Pb () n) has a capacity of up to A .-mg • g^{-1}, desorption efficiency up to , 3%. Fan etc [9] studied fe_3o_4-P cyclodextrins - chitosan / go Adsorption of nano-absorbent materials on dyes , beginning The ability to adsorb is , mg • g^{-1}, pass 5 secondary adsorption cycle past ,,, the adsorption capacity of methyl blue in wastewater can be maintained at upmg • g^{1} . ya 6 etc [4 °] prepared by Fe 3 O 4 / Go / chitosan Composite , apply it to enrichment of protein , adsorption amount reached 7 / mg • G^{-1} . ehsanetc [a] with 3- mercapto Propane to GC - Magnetic chitosan (go - MC) Composites modified , Prepare a New biological adsorbents , available in sewage Hg The pre-rich andextract . Jauvi etc [[] low on environment , (four Bromo) of a large hazard A The adsorption process for the was studied , prepared a pair of bromine bisphenol A (ttetrabromobisphenola,TBBPA), with high selectivity, and Magnetic imprinted composites with high adsorption capacity , to TBBPA The material saturation adsorption is 16 . mg • g^{-1} , and TBBPA Recycle efficiency up to ? 30% ~ , 60%,, instead of adding TBBPA Magnetic complex /binding materials only 0.mg • g^{-1}. research shows that , ZnO with chemical inertia [3], play a very important role in photocatalytic degradation of organic pollutants , however ZnO The can only absorb the of the ultraviolet region light for catalytic degradation , if in ZnO on doping Ni [A] , Strong adsorption performance on go [[] can significantly improve its degradation performance . Qin etc [+] system ready Ag/ ZnO/ go composite , to enable rhodamine after catalytic degradation The removal efficiency of the B is up to 90% .

2.2 Go progress in non-magnetic composite adsorbent Materials

non-magnetic Go The matrix composite is mainly for handling heavy sums of water pollution and organic pollution , is magnetic Go Important for matrix composites

To supplement , The also gained extensive research .

The chitosan molecule chain contains more than one NH2 and other active Group ,, make it unique physical and chemical properties and biological activation features ,thus The is widely used in sorption and Flocculation fields . But the mechanics of the chitosan itself Poor performance , restricts its application . and go have strong mechanical properties Energy and reactive activity , Many researchers will be chitosan and Go Composite The has been studied . go/cs composites adsorption for different contaminants can be as table 2 shows .

Luo , and so on [a] discovers , except that the chitosan contains more and more heavy metals away from the outside the group of children , Poly Keiva Oxygen House (P 0ly 3- aminopropyl - Triethoxysilane , PAS) contains a large number of a NH_2 , can be with - Some metal ions such as Pb () n) to form stable complexes . go with Large surface area and rich oxygen functional Group , on go Nano-Slice Turn the Polysiloxane Low poly (to 3- propyl Tri-ethyl siloxane for cross-linking agent) preparing high performance adsorbent , significantly improves the composite's

Adsorption Performance , in PH = 4 ~ 6 , temperature is 303 K PAS / Go , Go / As The maximum amount of adsorption for is 312 5,119.mg • G^{-1} , The adsorption capacity of polymer composites is significantly higher than that of PAS . complex Material's PAS /go process diagram 7 shows .

Xia , and so on [+] adds a different concentration of Go added as an admixture to the Poly

The is prepared by the phase transfer Catalysis method PVDF^go Composite Film , should be for adsorption removal of natural organic matter , adsorption performance increased 1 times . go addition increases the mechanical strength of the composite film [% one , and enhances antibacterial properties of the material [9, +] and penetration performance , for sewage The processing power is also elevated .

the current development direction of the adsorbent is high selectivity , High adsorption efficiency and high repeat utilization ,go The admixture helps to improve the adsorbent selection and adsorption efficiency .

3. Go Progress in photocatalytic degradation of composites

photocatalytic technology is widely used in the degradation of organic compounds [61-63] Substance , Research Find , catalytic capability of photocatalyst not only its crystal type , size and crystallization degree related , and tend to generate association with some materials Join action , such as carbon nanotubes , fullerene, graphene ,gowait for complex together with , can increase the transfer rate of photons in materials , Enhanced composite material
A light reminder of the organic matter in the waste water and the harmful gases in the air performance .

Zhang Jong [?] with Ti (so_4) and a different concentration of NaOH of different degrees of dispersion handled by Go dispersion Compound , after a dry to series TiO2/ Go Composite , To measure its photocatalytic degradation performance with a concentration of mg / L Methyl orange for is the target degradation , degradation Effect rate $_7$=1mgamin • g). after multiple cycle degradation and 4 Weekly exposure , its photocatalysis efficiency only slightly lower , Performance out very good reuse and chemical stability, to TO2 /go Composite materials in the catalytic degradation of waste water organic matter and air harmful gases provides additional references . Chen etc [before] preparation of by two-step modification Zno/go Composite material , and use the separately ZnO and Go compared to , The efficiency of photocatalytic degradation of methyl orange by composite is very significant . High . 0 out wait [+] will Ag nanoparticles and Go load to ZnO on , apply to degraded rhodamine B, The results indicate that , Composite material will be a catalyst extend from light to visible - UV light area , and get good reminders degrade . for rhodamine B catalytic degradation , , and so on ^^ takes the in-situ polymerization for multicomponent composites go- PA-CeO_x , knot
The fruit displays , polyacrylamide (polyacryl amide,PAM) The oxides of the and Ce load well in the go the nano-slice layer , and finally composite material and go Applied to the catalytic degradation of rhodamine B experiment , in

Comparison of under same conditions , past min and min Ultraviolet for lighting ,go and composite to Rhodamine Bdegradation efficiency is divided into not to 18%,31% [and 50%,80%, catalytic degradation of composites is significantly better than go .

To summarize , Go Photocatalysis Composites in photocatalytic degradation of the Realm shows excellent performance , reason for : (1 The introduction of) go increases the specific surface area of the composite to a large extent , Improve contact opportunities for composites with photons , Enhanced composite material material adsorption capacity for organic pollutants ; (2) in the composite interface heterogeneous junctions formed by improve the composition of optical electrons and cavities ; (3) Go introduced in _ Increase the absorption wave of the catalytic material to a degree. Long range , provides a for photocatalytic degradation in the visible light is possible .

4. Go Research Progress in biomedical composites

Go The enrichment adsorption of the biological protein by IS _ kind of nonspecific suction Attach , cause protein to occur aggregation , structural changes and loss of protein live sex [' all '. and polyethylene glycol (polyethylene glycol,PEG) is _ multiple _ hydroxyl compounds , has good biocompatibility , for cells and bio-protein adsorption is weaker . if poly (ethylene glycol) and "" Go are compound , can well improve go Surface property , and to form nano surfaces interacting with proteins , Improvement go Negative effects of the structure and activity of the protein on the . Chen etc [on] through the original bit growth and self-assembly method , will Feooh nanorods and passes through PEG Grafting modified Go to compound , The was prepared for biological whole blood albumin has efficient adsorption feooh- PEG ^ Go Composite , Results show ,The composite to bovine serum albumin (no heme red Vegetarian) Maximum adsorption amount up to 1377.4mg • g-^{1} , in PH = ~ The resolution rate for is 70%, is a good way to weaken the nonspecific egg White adsorption .

DNA fluorouracil glycosylation (Uracil-dna glycosylase , UDG) is an important shear repair enzyme , have maintenance gene structure end The effect of the integer . Zhou wait[all] Loads the tracer fluorescence probe to the Go Layer , To produce a Go Base bio probe , found in a wide dynamic State range (0 0017 ~ 0.8U/[] []/) has a good detection effect , and Minimum checkout limit 0.0008U / ML . parent out, etc. [[] using electrostatic spinning Wire Preparation of thermoplastic small diameter artificial vascular stent Polyurethane -go Composite , its mechanical properties , Surface Performance , stretch performance , Young modulus the ,, and hydrophilicity meet the requirements . on bacteriostatic aspects ,Andrea etc [More] to

AgNO 3 is the precursor of silver nanoparticles , sodium Citrate as stabilizer , will silver nanoparticles decorate to go slice top , To prepare the Go /Ag Nano composites , apply to inhibit Pseudomonas aeruginosa , after lh bacteriostatic experiment , antimicrobial efficiency of composite materials in half above . Justin etc [(a) in drug carrier research use cheap easy , biodegradable Shell Poly sugar and high mechanical strength , Specific surface area and many active functional groups go prepare nano composites , has potential application value in drug delivery devices . Wang etc [73] with magic lamb dextran (konjac glucomannan , KGM), sodium alginate (Sodium alginate ,SA) and go to originalmaterial , with Ca" do cross-linking agent to prepare hydrogels KGM / SA / Go , makes the anti-cancer drug up to controllable release , when PH = 1. 2 drug Balance releasedrop rate only 02% , and PH = 6. 8 , passes H after balance release rate up to ? 19% . KGM/sa/go The gel process as shown 8 shows .

Go Base Biomedical composites in the adsorption of specific protein , drug Object Carrier , Gene engineering and regulation of drug release etc. vary performance , with research in depth , believes Go Base Biomedical composite The material will eventually break through in the field of cancer prevention .

5. closing

is currently , Go the application and research of composites has become a research hot spots _, Reason go unique structure and performance make it form The composite material in strength toughness , adsorption separation and photocatalysis compared to has obvious advantages over traditional materials , satisfies the _ Some domain technologies Development Requirements for material performance . simultaneous ,go and other material shapes to

Composite is go Main ways to play the role ,where go In the Composite It also works with go The structure and performance of the system are very large Department . such as ,go Enhanced toughened polymer materials and cement-based materials , on the is through Go regulates polymer and cement-based materials , To form a rule an ordered microstructure to achieve its enhanced toughening . future ,go on enhanced toughening , adsorption detach , Development of functional composite materials such as photocatalysis trend is : (1) Go Preparation of composites and Go The role of in it principle is the focus of research ;(2) Go Enhanced toughened composites with production Industrialization , potential for scale application , where Go Enhanced toughened polymer materials material ,go Enhanced toughened cement-based composites , Go Enhanced toughened tao porcelainThe technology for materials has been relatively mature , to achieve industrialization seek ;(3) go Composite in adsorption , photocatalysis and Biomedical fields Research is still in research phase , about go composite Structures and The relationship between performance has not been established , Industrialization Key technologies not yet Master ,go The scale of composite materials , Efficient and reusable Technical issues have not been resolved , These aspects of industrial applications also need do a lot of research work .

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