Universe Scientific Publishing

ORIGINAL ARTICLE

Stilbene-based anthracene aggregation-induced emission material system of research progress

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Abstract: With aggregation-induced emission(AIE)Properties of Organic fluorescence molecular due to the distortion of molecular configurationIn aggregation state or solid-state show significantly enhanced the fluorescence emissionAvoid the traditional organic fluorescence molecular of Concentration Quenching PhenomenonSo in photoelectric devices,Biological sensing and field has a wide range of application.This paper mainly introduced the hasAIEProperties of stilbene-based Anthracene(DSA)Derivatives and Its in efficient solid-state luminescence material,Stimulation response Material,Biological imaging and biological and chemical sensing and field of study progress.

Keywords: Stilbene-based AnthraceneAggregation-induced emissionSolid State LuminescenceStimulation responseBiological ImagingBiological and Chemical sensing

1. Introduction

The earth improve the organic light-emitting material in actual application in performance.Nearly ten Plane of molecular configuration will produce is strong of molecularπ-πEach other roleTheIn recent yearsDomestic and foreign many study group have been reported and hasAIECharacteristics

In excited state of molecular will by non-radiation transition back to ground stateTo suddenOf molecularAnd by molecular structure design and aggregation state structure Regulation Optimization

Molecular OF LUMINESCENCE PROPERTIESHas developed from dark blue to near infrared cover the whole visible wavelength rangeAIEMaterial System[11].WhichStilbene-based Anthracene(9,10-distyrylanthracene DSA)And its derivatives has structure simple, easy to Synthesis(Synthesis route as shown in Figure1Shown in), Performance excellent and advantagesHas widely of application potential[12].This paper key introduced the hasAIEPropertiesDSADerivatives and Its in efficient solid-state luminescence, stimulation response, biological imaging and biological and chemical sensing and field of study progress.

2. Solid State Luminescence

BecauseAIEMaterial in aggregation state when has is strong of fluorescence emissionIts crystal, thin film, nano-material and can as an a kind of future of solid-state lights to Application.Figure2Given the part has is high solid-state luminescence efficiencyDSADerivatives of molecular formula. PrasadStudy Group[13]First reported the anthracene ethylene class Compounds1In aggregation state under fluorescence enhancement of Phenomenon.ThenThis study group[14]Reports.DSADerivativesAIEPropertiesAnd this based on development. A seriesAIEMolecularForAIEMolecular of study and development lay the foundation.This afterMore and more of Team attentionDSADerivatives of Proper-

ties and Application.As shown in figure3Shown inCompounds4In dilute solution in only weak of FluorescenceFluorescence efficiency can't1%,By in solution in join a lot of bad SolventMolecular the formation of aggregates show strong of fluorescence emissionFluorescence strength increase.100Times[14].Compounds2(DSA)And3The formation of crystal also have high of Solid State luminescence efficiencyRespectively50%And41%,Than solution state high nearly100Times.Crystal Structure and Theory Calculation of results show thatDSAMolecular double bond on theHAnd anthracene ring on the nearHWill produce strong of a resistance effect(Figure3),Lead to its molecular has very distorted of Structure[15].In dilute solution inMolecular in the vibration go movement make in excited state of the molecule is easy by non-radiation transition back to ground stateMake solution fluorescence is very weak even no fluorescence.And in aggregation state of molecular have rich of molecular between each other roleGreatly suppression the molecular in the vibration go MovementTo make Fluorescence Enhancement.

In addition to Single CrystalWe also report the based onDSAUnit of nano self-assembly structure. DSAMolecular and compounds17~19Can by again precipitation method formation micro-Nanocrystalline[18].Figure5Given the these micro-nano M Material of fluorescence microscopic photos.By compare the foundDSADerivatives micro/nano structure of morphology characteristics with end group there is an important.End Group does not contain of atomic of compounds formation micron scale of Structure.For exampleDSAMolecular can only formation rules of nano-Great StructureCompounds17Only the irregular of Sheet Structure.And introduction of fluorine atoms of compounds18And19Due to increase the molecular between of each other roleSelf-assembly can be formed after regular of one-dimensional nanowires Structure.Worth a mention of isThese nanocrystals have smooth surface and uniform size,And show good stability,No apparent aggregation occurs after a few days.

Compound22.~24Anthracene two divinyl(DVA)With carbazole at both endsDSADerivatives, 3All the compounds are obvious.AiePhenomenon and high solid-state fluorescence Efficiency,For respectively18.5%,30.2%And12.7%[26]. 3All compounds can be found in good solventsTHFMixed Solution with bad solvent water,Self-assembly into nano-aggregates.Among them,Compound22.And24Irregular bulk nanoparticles after self-assembly,And Compounds23.Regular nano-ring structure can be formed after self-assembly.These nano-rings have better stability Qualitative,Stable after two days in Solution,And has a strong green fluorescence,The fluorescence efficiency is up30%.

In addition to photoluminescence,High Solid-state fluorescence EfficiencyDSADerivatives can also be used in electroluminescent[21].Vacuum Evaporation of compounds20The fluorescence spectra of thin films are similar to that of crystals.,Fluorescence efficiency up38%.Will compound20As a luminescent layer,Add electron transport layer and hole transport layer on both sides,Non-doped organic light-emitting devices with multilayer structure(OLED).As shown in Fig.6.Shown,Device has excellent performance,Maximum Brightness achievable24750 CD $m^{-2.}$,Maximum current efficiency near10 $CD^{-1.}$,Maximum power efficiency7.78 lm $W^{-1.}$,For non-dopedOLEDIs a good result.Light emitting spectrum stabilization,The luminous color is yellow green,Color coordinate is(0.35, 0.55).

3. Stimulation response

Stimulation responseAIEMaterial is a kind"Intelligent"MaterialThey of absorption and fluorescence emission spectrum can in external stimulation(Such as pressure, heat, light,PH, Water, ion, organic small molecule and)Under Change.In recent yearsStimulation response luminescence material in fluorescence sensor, anti-counterfeiting paper, reversible writing media, memory chip, optical switch and field get the widely applicationSo by more and more the attention.

DSADerivatives has good of stimulation response properties[12]This classification introduced the figure7/In stimulation responseDSADerivatives.

3.1 Pressure Induced by color

Pressure Induced by color material is fluorescence properties with external pressure stimulation and change of a class of intelligent materialIn sensor, Intelligent Chip and anti-counterfeiting ink and other field has wide range of

application[27].This study group[28]Reported the double ortho pyridineDSADerivatives25When the grinding powder at the end ofIts fluorescence color by green into yellow;In static pressure underThe powder fluorescence final variable for red.Pool zhenguo Study Group[29]Reported the series of benzene ethylene and four styrene replaceDSADerivatives26~29These compounds with poly Set induced by Fluorescence Enhancement(Of The aiee)PropertiesAnd in pressure role under fluorescence have obvious changeAnnealing processing after and can recovery to initial state.

In additionSingle carbazole and three carbazole replaceDSADerivatives30,31All have pressure of color propertiesAs shown in figure8Shown inCarbazole group is more of compounds31Pressure of color effect more obvious[30].By study in different conditions under(Grinding, annealing and solvent processing)POWDER OF FLUORESCENCE CHANGEProves that as carbazole groups the introductionCan enhance powder of pressure of Color Characteristics.These excellent of performance make these compounds can as an stimulation response and luminescence material in record, pressure sensor and emitting get good of should be

Yang Wenjun Study Group[31]Study the has different length alkyl oxygen chainDSADerivatives32Study foundReplace-based length the short its material of pressure induced by color properties the obviousCombined with crystal structure shows thatReplace base of length will influence molecular conformationAt the same time also will change its aggregation state structureTo lead to different of Optical Characteristics.

3.2 Induced discoloration

Induced discoloration is refers to due to light before and after molecular structure changeMaterial of absorption and fluorescence spectrum Reversible Change of Phenomenon.In recent yearsHas photochromic properties of material because its in optical data storage, antiOne.Usually in underSPIn solution in by UV addressed to happen induced heterogeneous reactionForm conjugate of Cyanine(MC).The light induced heterogeneous reaction need to have a certain of free space to a anti-heterogeneous processHowever in molecular closely accumulation of solid-state underSPNo enough of free spaceSo very difficult to happen induced heterogeneous reactionThis serious limit the photochromic material of actual application.

RecentThis study group[32]WillDSAMolecular and twoSPMolecular by covalent bond non-conjugate evenGet the kind of new solid-state photochromic Material

As shown in figure9Shown inIn light and the irritation of heat underThe powder fluorescence will from yellow to red of Reversible Change.Study foundTo bodyDSAThe fluorescence spectrum and receptorMCThe absorption spectrum very big of OverlapAnd to receptor between distanceSo light after Will from to body to receptor of energy transfer.In additionDistortionDSAItself of space a resistance effect not only canSPOf induced heterogeneous reaction provide enough of free spaceAnd also will and open-loopMCDirect formation molecular in hydrogen bond to further promote light open-loop Reaction.

Intermolecular FormationC-HNInteraction,Fish bone shapeHGather.A slip between molecules in a symmetric protonated CrystalHGather,Electron Cloud delocalization caused by protonation reduces the energy of the system,RED SHIFT OF SPECTRA.The most closely packed molecules in asymmetric protonated Crystals,Formation head-Tail stacking Arrangement,The neighboring molecules have strongPi-piInteraction and couple Dipole Interaction,Therefore, the absorption and emission spectra are further red shifted..

3.3 Multiple stimulus response

Multiple stimulus response refers to multiple outside stimuli(Such as pressure, heat, light, solvents, etc.)Under the Action,Reversible Changes in the optical properties of molecules.Compound36The fluorescence of the powder changes from green to red after being fumigated with strong hydrochloric acid.[36],The fluorescent color can be returned to its initial state after being fumigated with Triethylamine.Simultaneous,Red shift of fluorescence of powders under pressure,The fluorescence can also return to its initial state after heating.Compounds with different lengths of alkyl chains32,Have varying degrees of response to multiple external stimuli[37].When$N \geq 10$Time,These compounds exhibit

obvious pressure-induced discoloration.,CRYSTAL STRUCTURE ANALYSIS,Supramolecular interaction has a great influence on the pressure induced discoloration properties.,Simultaneous,These compounds are significantly responsive to solvent vapor and Temperature.

4. Bioimaging

Biofluorescence imaging allows the visualization of cells or tissues in a non-invasive manner using fluorescent molecules,It can even locate and track biomolecules in complex biological systems.,Therefore, attention has been paid in recent years.With twisted ConfigurationAieMolecular,Such as Styrene(TPE)Derivatives,DSADerivatives and cyano-styrene Derivatives,Almost no fluorescence in Dilute Solution,However, the fluorescence is very strong at high concentrations or in the aggregation state.,This provides a new type of fluorescence imaging materials.

New Ideas[38,39].

WillDSAThe monomers of derivatives are formed by copolymerization with other monomers.AieAmphiphilic polymers of Properties,Stable nanoparticles can be formed through hydrophobic interaction in aqueous phase. DSADerivatives as hydrophobic ends,Gather inside Nanoparticles,Therefore, it has strong fluorescence emission.

MeldrumResearch Group[40]In cooperation with this research group, a new typeAieInclusion of propertyDSARandom Copolymers of Derivatives37(Figure11).By controlling the molar ratio of different components,Got a series of Amphiphilic Polymers,These polymer in water can form uniform, stable, size10 nmThe nano-particle.Study show thatPolymer in hydrophobicDSADerivatives content the higherThe formation of nano-particle of Fluorescence

Efficiency the higherThe highest up13%.Nano-particle can in physiological environment under stableCells toxicity experimental show thatThese nano-particle has very good biological compatibility.In order to get higher fluorescence quantum efficiency of nano-particleWill hydrophobic chain segment2,2 2-Methacrylic acid three Ethyl Ester(Tfema)Introduced Copolymer38[41]When polymer in Water Self-assembly formation nano-particle

Hydrophobic UnitTFEMAAndDSADerivatives closely to aggregation inBecome nano-particle of NuclearSo closely of aggregation can limitDSADerivatives of molecular Internal RotationMake its a stronger of FluorescenceTo improve the particle of fluorescence Efficiency.About1%Moore thanDSADerivatives suo ju synthesis of polymer of fluorescence efficiency can be reach up40%,About for Polymer37Of4Times.By and commercial lysosomal red dye and mitochondrial red dye in cells in of positioning experimentalIn addition to Pearson correlation testShow that nano-particle in lysosomal and mitochondrial imaging of correlation respectively69%And55%,Can achieve cytoplasm of Imaging.The nano-particle and commercial of dye comparedHigh fluorescence efficiency, simple preparation,

Easy to save and use,And achieve Cell Imaging well.Meanwhile,Polymer38Highly sensitive^{19}F NMRImaging Properties,Show it's in vivo.^{19}F NMRPotential applications for imaging.

We designed and synthesizedDSAA nuclear Amphiphilic Polymer

39(Figure12)[42],InDSAHydrophobic poly (ε-Caprolactone)(PCL)Chain segment, hydrophilic Polyethylene Glycol(PEG)Folate groups at the ends and ends of the chain.Polymer39Can be formed through self-assembly with monodispersity andAiePolymer Quantum Dots(Pdots). pdotsStable in the water,Average Particle Size15 nm,Fluorescence efficiency up27%.Ye

Acid-functionalizedPdotsHuman Cervical Cancer Cell Line(Hela)Cells have targeted Function,Available for targetingHelaCell Imaging.Dangerous Rock Research Group[43]The hydrophilic phospholipid Monomer(MTP)With hasAieOf NatureDSAAmphiphilic crosslinked polymers obtained from COPOLYMERIZATION OF DERIVATIVES40,Through the self-assembly method, the polymer can form30-20 ~ 50 nmNanoparticles,And has excellent luminescent properties,In a physiological environment,The nanoparticles have good stability, dispersion and biocompatibility.

Sex,Applicable to bioimaging.

Apart from WillDSADerivatives can be polymerized with other monomers to form amphiphilic polymers of

water-soluble nanoparticles.,You can also use hydrophobic water Interaction willDSADerivatives are coated with amphiphilic polymers into water-soluble Nanoparticles,And for bioimaging.Dangerous Rock Research Group[44]Using commercial surfactantsF127Will haveAieOf NatureDSADerivatives41Through things

Preparation of Water-Soluble Nanoparticles,The nanoparticles have good biocompatibility and Cell Imaging effect..Lu Hongguang Research Group[45]Lee Modified with folic acidF127CoatingAieCompound4.And double(4 -(N-(2-Naphthalene Ki)Aniline Base)-Phenyl)Cyanide maleate(Npapf)PreparedAie

Nature of nanoparticles.Compound4.As the giving body,Fluorescence peak and receptorNpapfThe absorption peaks overlap greatly.,Significant fluorescence resonance energy transfer between the donor and Acceptor(Fret),Fluorescence Enhancement of receptor molecules in Nanoparticles.Nanoparticles are well dispersed in Water,And less cytotoxic,Folate-modified nanoparticles can target breast cancer cells with folate receptor overexpressionMCF-7),Conduct Cell Imaging.In order to obtain nanoparticles with high fluorescence Efficiency,We designed and synthesizedAieNature of red light emissionDSADerivatives42[46].Using Amphiphilic Polymer Polystyrene-Polyethylene Pyridine(PS-PVP)Coated Compound42,It can form a stable particle size in the aqueous phase.25 NmMonodisperse Nanoparticles.As shown in Fig.13.Shown,With good biocompatibility, red-emitting nanoparticles can effectively achieve cytoplasmic and nuclear imaging..

Silica is a chemically inert material., DSADerivatives can form silica fluorescent nanoparticles by physical doping or covalent bonding with Silica,BecauseDSAIntramolecular vibrational movement of derivatives is limited,Therefore, silica nanoparticles have strong fluorescence emission.Fluorescent silica nanoparticles combine with Silica Surface Modification, good hydrophilicity, good biocompatibility, high thermal stability

PrasadResearch Group[51]A Method matching the energy of photosensitive materials was synthesized.DSADerivatives43.Compound43Weak fluorescence emission in Solution,With photosensitive drugsHpphWithSio_2.After the preparation of nanoparticles by re-Precipitation,Fluorescence enhanced significantly.In Nanoparticles,Compound43As the giving body,Photosensitive drugHpphAs a receptor,UtilizationFretPrinciple,Can successfully stimulate photosensitive drugsHpphAnd produce Reactive Oxygen Species,Effectively kill cancer cells,Achieve the effect of Photodynamic Therapy.Simultaneous,Compound43It also has two-photon absorption properties,Coating compounds with Silica43,Silica nanoparticles with two-photon absorption properties,Two-Photon imaging at the cellular level[52].

Dangerous Rock Research Group[53]Utilizing Compounds41Silica nanoparticles with high fluorescence efficiency were prepared with octadecyl trimethoxy Silane.Uniform particle size and excellent luminescent properties,Good water dispersion and biocompatibility,Cancer Cell Imaging.

This research group[54]UtilizationDSADerivatives44As the nucleus of nanoparticles,Folate-modified silica is a shell,Fluorescent silica nanoparticles functionalized with folic acid were successfully prepared.(Ffsnps)(Figure14).The particle size of the nanoparticles is about60 nm,Has a very high surface potential,And can be stably dispersed in the water,Fluorescence efficiency of nanoparticles20%.Introduction of folic acid on the surface of nanoparticles as the target base of cancer cells

5. Biological and Chemical sensing

Fluorescence Analysis Technology has the advantages of low background noise, high sensitivity, high selectivity and easy operation.,Has attracted much attention in the fields of chemistry, biology and environmental science..However,Quenching of many fluorescent materials at high concentration or aggregation state,Significantly reduce the detection signal,The practical application of fluorescence sensing system is severely limited..Will haveAieCharacteristic fluorescent probe introduced into sensing Platform,One can effectively avoidACQEffect;On the other hand,Fluorescence signal can be realizedOff"To"On"Process,Improve sensitivity of Sensing System.The following highlights the figure15Middle-basedDSAApplication of fluorescent probes of derivatives in chemical and biological sensing.

5.1 Ion Detection

Heavy Metal Pollution, such as lead ion, mercury ion, silver ion, etc.,A great threat to human life and health,Therefore, it is of great significance to develop a highly sensitive detection technology for heavy metal ions in environmental protection..Probe45Showing faint FLUORESCENCE IN SOLUTION,With$Hg^{2.}$Join,The fluorescence of the solution gradually increased[55].This is because the compound45Contain$Hg^{2.}$Thymine, a specific recognition group,Join$Hg^{2.}$Empress,The amino groups in thymine$Hg^{2.}$Forming a Coordination Bond,Limiting the vibrational movement of probe molecules,Give it a very strong fluorescence.When other heavy metal ions are added,Unable to form coordination key,Compound45Still dispersed in Solution,No significant change in fluorescence intensity.High sensitivity and simple preparation of this small molecule Fluorescent Probe,Detection Limit reachable340 nm.

In addition,We use a water solubilityAieProbe46(Figure16)[56],Binding aptamerOligo-CAnd nucleaseS1,RealizedAGHighly Sensitive Detection[57].In Solution,Compound46Completely dissolved causes the solution not to glow,When joiningOligo-CEmpress,Positively charged probe molecules and negatively charged probe moleculesOligo-CUnion,The solution gives off faint Fluorescence.When joiningAGEmpress, Oligo-CThe cytosine bases inAGForming a Coordination Bond,InductionOligo-CBy random structure into stabilityUStyle structureMake its can't be nucleaseS1HydrolysisProbe Molecular internal rotation further limitedMake solution Fluorescence Enhancement.InsteadWhen join other heavy metal ion whenOligo-COf conformation not changeAnd was nucleaseS1Hydrolysis into broken

TabletsCan't make molecular aggregationSolution no fluorescence.This methods implementation.AGOf non-mark, High Sensitive DetectionDetection limit155 nm.In additionRich in guanine base of Single ChainDNA (ssDNA)Can in cationic of role under formation stabilityG4ConjoinedWhich can be used to develop based on Probe Molecular and thrombin aptamer(TBA)The selective strong, sensitivity High Lead Ion Detection Methods[58].

In additionYang Chu, Study Group[59]Based onDSADesign Synthesis the dual-core ZINC COMPLEX47And48Implementation The the citrate of Detection.Complex inDSAHasAIECharacteristicsBut dueZnHas diamagneticComplex can't by electronic transfer quenching hair color group of Fluorescence.When join indicator of redPhenol red and47Or48Formation new OF COMPLEXMolecules in Charge TransferSolution of the fluorescence quenching.With the target anion citrate of joinPhenol red was releaseAt the same timeComplex47Or48And citrate of combined with will limitDSAOf molecular in RotationFluorescence gradually enhancedImplementation The the citrate of Quantitative Analysis.

5.2 PHDetection

Even amino and hydroxylDSADERIVATIVES OF SOLUTIONPHVery sensitive[60].Compounds49InPH> 10The solution inAlmost no fluorescenceWhenPH <10An arcaneSolution of fluorescence gradually enhanced.WhenPH = 6An arcaneSolution of fluorescence strength to maximumIsPH = 10.3When140Times.This is because in alkaline conditions underMolecular of hydroxy transformation for alcohol sodium saltMake its dissolved in solution inWith the solutionPHOf reduceAlcohol sodium salt structure gradually reduceThe molecular began to gatherSolution of fluorescence also increases.Compounds50Based on the same mechanism also canPHThe detectionInPHIs high when fluorescence open.

Applied to Biological Detection in.This study group[61]Use water-soluble Probe Molecular51Implementation The the nucleic acid enzymeS1Of Detection. S1Enzyme specific to WillSsDNA,RNAAnd double-strandedDNA (dsDNA)In single chain part enzymatic hydrolysis into nucleotide Fragment.As shown in figure17Shown inCompounds51Of aqueous solution no fluorescenceWhen joinSsDNAAfterWith negativeSsDNAAnd with positive of Probe Molecular by electrostatic role and hydrophobic the role of the combinedProbe molecular aggregation make solution Fluorescence Enhancement.When joinS1Enzyme afterSsDNAWas enzyme cut into fragmentMake a large number probe molecular dispersion in aqueous solution inSolution of fluorescence weakened.By OBSERVE THE SOLUTION OF FLUORESCENCE CHANGECan achieveS1Enzyme of Specific Detection.In additionBecauseS1Enzyme of activity

can be inhibitor RegulationBased on this a kind of methodsS1Enzyme inhibitor can also be screening out.

In recent yearsCarbon nano-materialSuch as oxidation graphene(GO), Water-soluble carbon nanotubes(CNTS),Due to its excellent of physical chemical performance and on the luminescence molecular super of quenching AbilityBecome Biological Sensor IN THE FIELD OF HOT.Study show thatGOCan selective adsorptionSsDNA,And for double helix structureDsDNAOr folding degree highSsDNA GOThe ITS of adsorption role is weak.Based on thisThis study group[56]Use Probe46AndGO,Implementation The the targetDNAOf"Turn-on"Recognition.Probe46In aqueous solution in fluorescence is weakJoinSsDNA (P1)AfterP1And Probe46Aggregation Formation Complex1,Solution of Fluorescence Enhancement.When joinGOAfterComplex1Was adsorptionGOOnSolution of the fluorescence quenching.With the complementaryDNA (T1)The additionP1AndT1Combined with formationDsDNA,And then break freeGOOf boundAt the same timeProbe46AndDsDNAFormation new OF COMPLEX2,The fluorescence of the solution gradually increased,Achieve the goalDNAOf"Turn-on"Recognition.

In order to understand the sensing mechanism of the system and optimize the sensing performance,We also studiedAieProbe,DNAAndGoInteraction,Achieving high sensitivity and selectivityDNAConstruction of sensing Platform[62].Research findings,Probe Molecule andDsDNAClosely integrated through the embedded role,Not easy to beCNTSAdsorption;And changeDsDNASequence,Mutation in one of the bases,Would break the double helix.,Weaken the binding of probe molecules to mutation sites,Easy to beCNTSAdsorption,Weaken the fluorescence of the Solution.Based on this,We use probe molecules46AndCNTS,Non-labeled single base mutationDsDNADetection[63].

With cationic probe detectionDNASimilar,AnionAieProbes can also detect proteins by electrostatic and hydrophobic interactions.This research group[64]A water-soluble sulfonate was designed and synthesized.52,In Solution,Weak fluorescence of probe molecule.When bovine serum albumin is added(BSA)Time,Probe Molecule entryBSAThe hydrophobic cavity of the folded chain gathers,Light up the fluorescence of the Solution,So as to achieve detectionBSAPurpose.In addition,Probe molecules can also be detectedBSAChange of folding Structure,When sixteen alkyl trimethyl ammonium bromide is added(CTAB)Time, BSAThe hydrophobic cavity of the folded structure is destroyed,Probe Molecule Unable to gather,The fluorescence of the solution weakened.

Ouyang Jin Research Group[65]Using sulfonatedDSADerivatives53As a fluorescent probe,Erythropoietin(EPO)The folding process realizes real-time monitoring.Probe molecules barely glow in Solution,When joiningEPOEmpress,Probe Molecule andEPOThe hydrophobic Cavities Combine and gather,Solution fluorescence is lit,Detection Limit reachable1 nm.When adding protein denaturants Guanidine Hydrochloride(Gndhcl)Time, EPOFrom Initial folding structure to random coil structure,In the process,Probe Molecule andEPOThe combination,Fluorescence Quenching of the Solution.

5.3 Biological Small Molecule Detection

Apart fromDNAAnd protein biomacromolecules,Many biological small molecules, such as Adenosine Triphosphate(ATP)It also plays an important role in complex biological systems..As shown in Fig.18Shown,We chose to be specific.ATPSingle ChainDNA-1As aptamer,Using molecules46And water solubleCNTSSpecific detection targetATP[66].First of all,Probe Molecular andDNA-1CombinedSolution a weak of FluorescenceWhen joinCNTSAfterSoluble

Liquid of fluorescence Will was Quenching.JoinATPAn arcaneATPAndDNA-1Formation new OF COMPLEXAnd fromCNTSSurfaceAt this time Probe Molecular still adsorption in Complex SurfaceSolution of fluorescence with was light.HoweverWhen join other adenosine class material whenAnd can't andDNA-1Specific combinedDNA-1And Probe Molecular still tangles inCNTSOnSolution no fluorescence.SoBy observe the Probe Molecular of fluorescence strength changeCan achieveATPOf high sensitivity Specific Detection.

6. Conclusion and Prospect

This paper introduced the series of hasAIEPropertiesDSADerivativesAnd TraditionalACQFluorescence dye

differentThese compounds in solution in luminescence is weak or don't LuminescenceAnd in aggregation state under fluorescence significantly enhanced.

Because Active of molecular in vibration go movement annihilation the ITS in solution state under of excitonAnd in aggregation state underDistortion of molecular configuration the produce of rich of molecular between each other roleLimit the molecular in the vibration go MovementTo make molecular can effective to Luminescence.Because this kind of hasAIEProperties of compounds in aggregation state or solid-state under show excellent of Luminescence PerformanceSo in efficient solid-state lights, intelligent material, chemical biological sensing and field exhibit a wide range of application prospects.OkayDSADerivatives of StudyRich.AIEMaterial SystemBroadenAIEMaterial of application fieldDeepenAIELuminescence mechanism of understand.In shortIn-depth StudyAieSTRUCTURE AND PROPERTIES OF COMPOUNDS,And establish the relationship between the material structure and Luminescent Properties.,It provides a theoretical and experimental basis for the Design and Synthesis of New High Efficiency luminescent materials and their wide application in important fields such as chemistry, material electronics, life sciences, etc..

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