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skin next discovered could weave natural synthesis method processing mechanical characteristic fibre like cotton silk create cloth technological revolution 9 choosing right kind size quantity reinforcement previous two century primarily responsible essential customizing characteristic metallic matrix exponential growth human knowledge wattle daub used tribological characteristic hybrid composite made magnesium wall construction almost 6 000 year first example com reinforced graphite nanofiber gnf alumina short fiber posite material made used human construction material Al_2O_3 subject one investigation 10 13 synthesis mainly superseded concrete composite material made characterization healing evaluation mechanic self healing cement reinforcement like gravel aggregate sometimes known metal matrix composite shmmcs reinforced shape memory loose stone many million metric tonne concrete produced alloy sma examined different study additionally study worldwide year concrete muscular compression strength looked application laser additive manufacturing relatively weak tensile strength due mechanical characteristic several mmc kind design material interaction 4 metal matrix reinforcement technique synthesis used natural fibre composite originated environment manufacturing process resulting microstructures egyptian indus valley civilization clay reinforcement property main topic study production use first utilized building material biodegradable easily mmcs advanced demonstrated recent study 14 available low cost posse moderate strength engineering composite appropriate range product based manufacturing making artefact etc 5 steel reinforcement frequently added process due distinct mechanical electrical chemical concrete casting increase strength prevent failing thermal characteristic tensile stress fibre reinforced composite another popular construction example building bridge automobile type frp carbon fibre reinforced composite popular industry example car body aeronautics requires mate lightweight easy variation mechanical proper rial property high strength low density tie intensive bond hydrogen vander waal manufacturing household industrial component example force carbon reinforcement agent coalition become unbreak storage tank bathtub washing sink shower stall able 6 medical field area composite find practical application frps either glass reinforced plastic carbon fiber instance biomaterials tissue engineering goal reinforced composite cfrc carbon glass utilized make multidisciplinary discipline biomaterials engineering improve cfrc grp respectively form fiber inclusion epoxy medical diagnosis treatment using engineered material 10 resin thermoplastic frequently employed binding matrix biomedical engineering us engineering principle medical biology material composite wood mainly constructed thin layer hard material science engineering collaborate improve human wood board bound together one many composite 5 others health understanding human anatomy physiology essential include ceramic matrix composite cmc metal matrix composite field since knowledge used create biomaterials mmc polymer matrix composite pmc composite acm completed implanted human carry intended traditional composite include made ceramic metallic function without causing harm host organism different polymeric matrix ceramic matrix composite cmc metal matrix biomaterials classified based efficiently fulfill composite mmc polymer matrix composite pmc due designated task 11 composite biomaterials fall category utilization high strength low density fiber conventional composite increasingly used vitro vivo application superior strength stiffness elastic modulus acms 6 multiphase material simple produce allowing novel material stand ease production shape property change volume ratio ingredient resistance chemical heat creep synthetic material size shape orientation distribution fiber particle kind plastic significantly advanced thanks research creation matrix etc readily made get desired material quality plastic made various source including inorganic chem composite unlike metal polymer ceramic nearly icals biological matter synthetic chemical synthetic organic plas combination property simply changing constituent part tic essentially polymer often referred word polymer study aim introduce reader composite biomaterials explain made without constituent monomer possible application replacement repair component monomer composed carbon hydrogen atom trace amount analyze recent development study area benefit element oxygen nitrogen chlorine silicon may also drawback metal polymer ceramic biomaterials dis present polymer often take shape extremely long chain cussed 12 reason writing review composite may linear branched numerous location carbon atom application provide complete review factor mix easily element one another 7 create drive research use fascinating material solid anchor carry load considerable distance high strength lightweight characteristic pliable design strung together review provides overview advanced fiber durability versatility ability sustain com reinforced polymer frp composite material including posites continue attract engineer researcher across globe

manufacturing technique property application author knowing way understand constantly changing world discuss various type fiber matrix reinforcement architect composite material numerous application contribute tures highlight key advancement composite material technological advance define contemporary world composite two essentially different element mixed providing thorough understanding composite material generate substance property exceed constituent us aim paper goal investigate characteristic 2m bhong et al e r l p r c e e dingsxxx xxx xxx benefit drawback composite material range industry including construction automotive aerospace review also look recent development composite material talk might affect next technology researcher better knowledge composite material use contemporary engineering shaped world end review 2 need composite benefit several advantage composite seen using metal wood composite real benefit lightweight relative stiffness strength lighter car quicker acceleration get worse gas mileage shot golf tennis archery benefit lightweight composite increasing accuracy 13 wind turbine efficiency increase blade become smaller lighter rubber wheel primarily replaced wooden counterpart colorful nylon polyester largely replaced cotton woman fashion lightweight aluminum tennis racket replaced mainly heavier wooden predecessor name instance despite higher initial cost due numerous desired quality composite increasingly adopted favor conventional material 14 composite material important address challenge dustries around world material effective afford able way protect metal component corrosive chemical like fig 1 material used boing787 body 16 acid rain salt spray lightweight high strength property also contribute fuel economy reduce operational cost lighter alternative 17 besides aerodynamic material transportation therefore environmentally friendly alter must simple manufacture stable even high temperature native traditional material offer new opportunity corrosion proof sustainable option created discov biomedical industry developing biomaterials replace ered composite material used used repair damaged tissue adaptable allowing new design continue utilized fulfill material need sector possibility compromise performance strength lead final quality manufactured composite material determined increase efficiency productivity across industry attribute constituent well quantity shape instance carbon fiber reinforced composite five time distribution attribute 18 however material engineer strong 1020 grade steel weigh one fifth much 15 frequently engage latter mass fraction volume fraction carbon fiber composite seven time strong 6061 two way describe proportion various stage compo grade aluminum modulus twice high metal nents composite consist matrix additional element polymer ceramic inorganic glass composite inclusion dispersion phase matrix often material example material metal shorter lifespan subjected relatively high flexibility moderate fracture strength shape high temperature general polymer rich material potential distribution latter stage significantly impact ultimate char function much chillier temperature despite strength acteristics composite material scattered phase geometry refers thermal expansion capacity ceramic polymer prac particle size shape whereas distribution includes tical structural material since become brittle high tempera position orientation within matrix 19 tures shown fig 1 general sense composite composite material broken several category categorized one following thanks evolution time work many writer fiber composite fiber support stability straight three main group assigned two shape type composite use reinforcement fiber reinforced compos particle composite put differently particle serve ites use inclusion fiber like property particle strengthen matrix particle randomly distributed reinforced composite use inclusion uniform ax 20 trix support manner consistent direction con construction composite hybrid modern composite struction material synthetic must excluded conventional material therefore primary distinction flake composite flake strengthened two di first two category particle geometry dispersed phase mensions due shape common find glass mica fiber type particle like natural fiber irregular geometry flake makeup excellent length diameter ratio particle type particle laminar composite layered two layer tend spherical particle fiber reinforced composite different material make laminar composite separated several group depending matrix used combined composite composite made blending different three major category composite metal matrix substance addition many composite fused create single polymer matrix ceramic matrix particle product reinforced composite strengthened adding short particulate composite play unexpectedly significant role driving inno composite categorized large particle dispersion vation electronics industry material offer several advan strengthened based average size reinforcement 21 tages others metal alloy ceramic polymer including large particle diameter least millimeter ability produced precisely controlled chemical mechanical former kind bear brunt stress help keep matrix thermal physical property high mechanical

strength stiff deforming two surface meet limitation presence abrasion wear resistance typically associated many mean large particle composite strengthened heavy material aerospace industry always looking 3m bhong et al erlprce edingsxxx xxx come mechanical stress matrix bear brunt weight material used construction manufacturing three leading dispersion strengthening composite despite including nanometer sized composite biomaterials particle reinforced fiber reinforced particle strengthening mechanism occurs atomic level structural performance characteristic composite scattered particle stop dislocation line spreading along biomaterial always constituent piece matrix come composite material approach far matrix inclusion matrix inclusion evaluating quality popular option 22 system consists fiber made composite made polymer pmcs crucial non mechanically superior material high strength destructive nde method play key role evaluation ultra elasticity embedded matrix made material like metal sonic testing valuable tool measure ultrasonic wave frequency polymer ceramic power stiffness composite frequency attenuation allows detection imperfection mined individual component characteristic also damage pmcs varying fiber orientation monitoring length diameter ratio fibrous phase arbitrary hit ae energy generated help detect classify various essential parameter 23 emission signal mechanical testing process known ae fiber reinforced composite divided three primary testing allows assessment subsurface pmcs mea group continuous long aligned discontinuous short sures heat loss cooling curing using infrared thermography aligned intermittent randomly oriented composite react thermographic testing tensile load term stress strain relationship depends cardiovascular system also known circulatory system orientation load concerning fiber longitudinal axis 24 play crucial role maintaining internal body temperature composite thread run straight direction affected vital function 31 heart vascular system blood make fiber randomly orientated continually oriented circulatory system blood job carry oxygen display contrasting quality stress strain illustration including nutrient around body heartbeat blood flow thread matrix composite failure strength stiffness fiber vein capillary metabolic waste flushed away heart material typically much higher matrix failure strain condition congenital acquired coronary artery dis significant even fiber brittle matrix ease cad arrhythmia may necessitate surgery therapy result failure strength harmony fiber reinforced composite extreme situation cardiovascular trauma surgical intervention midway individual fiber matrix 25 required replace repair damaged part system cardiovas structural composite collection adequately made composite cular biomaterials include pacemaker stent two well held together uniform adhesive solution structural composite known device angioplasty surgical treatment us biomaterial final quality mechanical structural integrity defined stent repair prevent blockage blood vessel bodily composition component ingredient geometry passage caused disease damage passage include design including size shape substantial building heart artery vein pharynx digestive tract 32 part 26 sandwich panel laminar composite two additionally polymer used momentarily maintain open common structural composite stalking gluing together two channel medical procedure traditional stent material include dimensional sheet carefully chosen high strength orientation stainless steel iron alloy titanium alloy magnesium yield laminar composite individual sheet large ratio cobalt alloy plastic 33 however composite biomaterials surface area thickness term two dimensional including metal polymer matrix composite emerging func invented describe result sheet typically composite tion superior alternative due versatility stent design low material aligned fiber reinforcement sandwich panel soft cost biodegradability ease production composite gaining inside surrounded tough outside making different popularity providing temporary vascular assistance body laminar composite 27 laminating agent hold two absorb newer composite stent biocompatibility ach part together outside skin fabricated metal laminar ieved design considers stent material surface composite like plywood fiber reinforced polymer teracts surrounding biological tissue material cause le extremely strong rigid hand core material often irritation vascular tissue 34 made wood honeycomb thermosets one crucial life sustaining device heart previously indicated extensive range composite pacemaker biomedical engineer developed functioning diverse combination attribute made possible distinctive correctly tiny electrochemical mechanism regulates heart design production freedom unlike conventional material like rhythm guarantee enough blood pumping circulation steel value composite characteristic fixed advance throughout body 35 four essential component pace 28 however strength weight ratio composite rela maker lithium ion battery lead connector block tively poor versatility led incorporation enclosure case containing pulse generator battery connect numerous field including medicine transportation even space ing block surgically

implanted beneath skin head travel composite typically designed surpass performance lead conductive tip surgically inserted desired heart alternative material fulfill specific load requirement type chamber information connected connecting block via composite several application medical field widely subclavian vein traditionally metal like platinum alloy applied medical field used everything utilized pacemaker construction recent year com diagnosing treating injury working biological material posites used due lower toxicity lower environ properly fabricated composite biomaterials used mental impact composite lighter taken place metal replace supplement organ damaged due traumatic shell device like pacemaker decrease pacemaker related skin pathological event 29 ability design composite biomaterials reaction observed former excellent tailored physical chemical mechanical property corrosion resistance former 36 specialized application significant factor widespread incisor canine premolar molar work together break adoption modern medical practice although biomedical engineering food smaller piece easier swallow four canine historically used natural synthetic biomaterials advent teeth adjacent incisor tear food apart premolar composite profoundly altered field constant improvement molar accomplish crushing use eight front teeth incisor material groundbreaking design enhanced cutting human dental system crucial speech sound medical device increased survival rate accident disease production dental plan susceptible abnormality damage well quality life life expectancy 30 like composite sickness trauma congenital condition much like 4m bhong et al e r l p r c e e dingsxxx xxxx xxx body part genetic defect also explain tooth loss dental composite biomaterial polylactic acid hyaluronic acid ester abnormality two common dental illness plaque damaged ligament mend reduced wear caries commonly known tooth decay former biofilm built prosthesis behavior ethylene butene copolymer compos bacteria due lack oxygen bacteria make lactic acid ites ultra high molecular weight polyethylene uhmwpe rein dissolve phosphate calcium enamel making weak forcement cyclic loading investigated discovered susceptible infection microorganism like love food right copolymer type angle combination com scrap get stuck around people teeth meal posites could made exceptionally fatigue resistant biomedical depletion bone building mineral like calcium phosphorus application time went researcher found fatigue lead tooth decay eventual loss contrast prevalence resistant material could used create ligament prosthetic cavity youngster may traced back food consumed 37 despite evidence animal study suggesting pet reinforced traumatic tooth damage might compromise tooth structural phema cartilage prosthesis cause synovitis used integrity make susceptible infection since turn high strength composite material made fusing terephthalate poly century head trauma become increasingly common due acci ester fiber collagen matrix created combat issue dent act violence devastate person oral health six month vivo testing material negatively become common practice employ composite biomaterials interact host tissue still promote growth polymer matrix composite dental implant restore lost teeth penetration fibrous tissue prosthesis host bone functional aesthetic purpose alternative joint meeting place two bone body biocompatible conventional metallic dental biomaterials like silver connective tissue allow mobility support entire body amalgam aluminized silver mercury filling incredibly human body 300 joint see regular use un harmful acrylic resin lack stiffness mechanical strength fortunately dislocation fracture form joint injury necessary serve prosthetic posterior teeth lifting flap typical result extreme case arthritis trauma may necessitate joint exposing bone replace missing broken tooth first pilot replacement surgery many case joint brought back hole drilled bone secure screw holding bone piece health using therapeutic method surgically exposing head place last step prosthetic tooth abutment screwed prosthetic femur tibia stem drilled patient place natural femur tibia together component provide movement common option permanent bridge analogous natural knee removable dental prosthesis denture wearer limit use lot similarity function knee removable dental prosthesis cause discomfort hip joint hip replacement surgery option patient prolonged use item often fabricated using corrosion resistant experienced severe damage hip joint metal polymer ce polycarbonates reinforced glass fiber ultra high molecular weight ramics composite frequently used constructing polyethylene commonly used construction fixed bridge biomedical instrument 38 acetabular cup shell implanted methacrylic matrix composite reinforced fiber inorganic pelvis using fixation agent stem leading ball particle discovered posse improved mechanical placed femur alloyed metal metallic composite typi aesthetic quality compared typical polymer matrix composite cally utilized branch material excellent strength used dentistry dental material containing titanium hydroxyapatite tension compression compared ceramic biomaterials com also gaining

attention bioactive compatibility positive metal significantly higher resilience wear consequently surrounding tissue hydroxyapatite chosen lower part employed construct ball implant titanium used upper section due treatment bone fracture composite successful incredible mechanical strength bone unique makeup tailored cartilage flexible elastic kind bone found specific function superior performance material dramatic ear nose rib joint adult help keep skeleton ically aid bone growth healing thus compatibility place material make majority structure newborn beginning composite utilized framework biodegradable giving place rigid bone formation later polymeric remain even intended purpose fulfilled composite poly 2 hydroxyethylmethacrylate phema com composite may also used internal fastening mechanism bined polyethylene terephthalate pet synthetic fiber past made metal metal mechanical aid incredibly utilized replace cartilage either absent birth destroyed long lasting deteriorate quickly stiffer bone development trauma cause possible mimic painful 39 one practical answer problem polymer property natural cartilage modifying volume two composite carbon fiber based polymer could used make device component biomaterial composite biomaterials including support healing bone high strength elastic ultra high molecular weight polyethylene hyaluronic acid also quality similar natural bone due nature used cartilage substitute high durability make common material risk corrosion biodegradable matrix used choice replacing damaged joint cartilage spinal fibrocartilage construct implant break bone heals releasing meniscus wear exhaustion repeated stress significant cause necessary drug artificial cartilage failure made steady progress toward bone cement help repair broken bone prosthetic joint finding answer problem injectable hydrogel polymeric easily implanted used achieves result regular biomaterial occasionally used composite biomaterials cement thick moist material used seal area natural reduce wear expedite healing bone meet metal plastic implant adhesive cure fill ligament fibrous fiber connect bone cartilage space part bind together securely poly many athlete injury anterior cruciate ligament acl merization process creates bond two substance repairing replacing tissue polymeric composite bio stable long lasting cast made using fiberglass polyester material help arthritic damaged joint usually function similarly fabric polyurethane matrix rather traditional cotton artificial cartilage artificial ligament wear eventually break plaster 40 model made composite material robust due repeated tension wear inclusion durable weatherproof amenable creating high quality x ray scan since easily worn poor flexural torsional despite challenging eliminate benefit outweigh strength cause synovial membrane inflammation use drawback recent year new method used ligament tissue substitute researcher created biodegradable alternative conventional one emerged 3 printed composite 5m bhong et al e r l p r c e e dingsxxx xxxx xxx casting web like shape increase ventilation delivering manufacturing technique including 3d printing automated layup benefit regular mixed cast also allow development procedure making transportation vehicle lighter improving patient specific ergonomic solution boost health well efficiency renewable energy source composite material help 3 printing speed quality improvement continue may replace reduce energy consumption composite useful application conventional manufacturing method composite material electronics telecommunication radar system may basis cutting edge design external prosthesis composite manufactured particular electromagnetic property supplanted wood metal leather composite preferred since keep best feature material made 3 fabrication method also adding benefit contemporary engineering manufacturing effect com rapid development short period hard positive material sophisticated production process crucial sub believe composite decade old ceramic show ject special quality composite material promise structural application still challenge made variety component specific property overcome price competition cause significant shift composite transformed number industry use pertinent data market 41 molding procedure used create many different reference discuss important influence composite composite good many technique shaping include shown trials advanced manufacturing process section fig 2 excellent strength weight ratio composite manufacturing process include casting centrifugal casting great choice industry like aerospace automotive continuous casting slip forming press molding transfer molding pul reducing weight crucial composite material great strength trusion molding filament winding addition method durability make ideal longer lasting already mentioned method include thermoplastic molding dependable product variety industry construction vacuum infusion wet lay compression molding computer numerical control composite naturally resistant corrosion merical control cnc filament winding used severe setting application traditional formulator business combine raw material trials might eventually degrade mechanical property com

semi finished product finished good create new product precisely tailored engineer using advanced necessary blend mix otherwise shape element natural manufacturing process enabling design material specified synthetic origin usually incompatible word formulation quality wide range application composite combined used characterize method therapeutic benefit material create unique pattern multipurpose com drug without presence active component paint ponents molding intricate shape composite production cosmetic cream mayonnaise composite material made using become economical effective thanks advanced light dispersion numerous immiscible phase seem homogeneous fig 2 fabrication method 42 6m bhong et al e r l p r c e e dingsxxx xxx xxx macroscopic size heterogeneous microscopic scale weight ratio 43 reduced stiffness fatigue increased toughness 42 success entire section hinge method mixing superior resistance corrosion excellent utility protection durability resulting mixture composite material electricity fire element ease fabrication familiarity take outstanding quality different substance combine range fabrication procedure longer longevity lower expen one matrix embedded composite often classified ditures many industry composite invaluable shown based configuration reinforcement also known fig 3 filler matrix help maintain order consistency load composite may transfer load stress substance 4 1 use composite aerospace structure history inconsistency even anisotropy result many variable matrix charge type charge shape composite frequently used construct various aircraft acces amount charge concentration interface quality manufacturing sories including door ring tip duct fairings random dielectric process impact final product quality composite panel mechanical electrical application epoxy resin e permutation nearly endless wide variety rein glass roving used high strength durability 44 polar forcement matrix material metal ceramic plastic rule winding term used describe technique used exceptionally composite material continuous phase one robust robust able make incredibly complicated pattern discontinuous phase many distinct intermittent phase found also resistant rust rust alignment dimensional stability hybrid composite matrix constant reinforcement supplementary two feature preserved probability dielectric change outstanding quality many material synthe breakdown minimal maximum possible level efficiency sized one composite synthetic polymer matrix mechanical reached thermal property enhanced using highly modular however essential consider potential downside well inforcements extreme tension production composite using delamination separation laminate layer layer interface polymer matrix provides greater design freedom metal due mechanical stress blow drop temperature one benefit include decreased fuel consumption airplane car fiber may get detached matrix material must increased range payload missile faster timing sport characteristic included first table due versatile transport reinforced plastic rubber steel organic resin glass fiber nature array valuable feature composite find use various carbon boron example inorganic composite resin field composite material currently actively integrated short fiber material ceramic composite carbon carbon aerospace program image show benefit composite made carbon carbon fiber concrete made greatly exceed potential downside experiencing flurry cement sand additive example mineral compos hydraulic action subtle disturbance discrete arrangement ites ceramic ceramic fiber another product composite part problem production expected bearing metal formed example aluminum carbon fiber boron strength composite lower metal fig 4 display car aluminum fiber packaging automobile light structure civil bon fiber potential 2017 45 49 engineering aviation sport biomedicine thermomechanical compo aerospace industry relied heavily autoclave since composite nents aerospace field benefited primary raw material glass fibre reinforced plastic composite composite commonly used low speed aircraft hand traditional mmc machining always unique typically done apart metal tooling way go mass producing identical item popular traditional metal alloy type mmcs made injection molding using resign work particularly well producing soft matrix e g mg al ni c ti etc reinforced hard particle e complex shape randoms random act shield elec g sic al2o3 emphasize natural progression material tromagnetic transmission allowing travel farther le atten removal process impact manufacturing productivity uation 51 random two crucial characteristic constant machining mmcs common occurrence include tool damage abrupt electrical thickness wavelength compatible radar breaking excessive wear mechanism bad surface workpiece equipment use titanium aluminum based alloy first quality degradation excessive rate plastic deformation oc material used make aircraft know carbon fiber reinforced cur material removal process cause significant composite cfrc introduced aerospace industry address heat generation owing mmcs ambiguous structural integrity various issue lack mechanical strength complex shape fa variety variable

procedure adjusted seamless tissue fracture resistance also addressed static dynamic material removal process therefore distribution reinforcement resistance corrosion resistance engine vibration reduction higher rate mmcs portion fabrication process play crucial role fuel consumption extensive research field produced structure property composite material relative strength aluminum alloy 7075 t6 cf reinforced selection cooling lubrication procedure must taken ac polyester composite ti 6al 4 v validated composite count based cutting parameter number writer material used aerospace three component excellent static embraced sustainable machining method handling material fatigue stress management efficiency 52 55 difficult cut milling process high density composite material one view experimental example machining 4 2 automobile transportation industry procedure material removal process dense reinforcement workpiece potential fracture harm cutting composite material garnered lot attention auto tool create surface fissure dynamic cutting process motive transportation industry due possibility improved altered soft matrix material abrasive hard additive mpg decreased vehicle weight 56 industrialized country combined composite material result various machining tech like japan graphite dispersed aluminum composite commonly niques dry mql cryogenic flood high pressure flood used make frictional auto part composite used extensively machining process must used counteract obstacle automobile railroad industry three wheeled vehicle disabled taxi delivery truck sport car ambulance caravan mo 4 application composite bile shop made glass fiber polyester epoxy composite outside united state grp also used motorcycle composite property set apart scooter industry need lightweight weather material capacity transported easily high strength resistant aerodynamic fairings several industry maritime 7m bhong et al e r l p r c e e dingsxxx xxxx xxx fig 3 sector wise composite material 44 fig 4 carbon fiber potential 2017 50 chemical mechanical civil electrical electronic play essential researcher focus particular region make significant contri role economy 57 60 future study composite material butions field composite material ought concentrate number important topic automation additive manufacturing two example advanced production sys 5 conclusion tems present chance accuracy efficiency investigation nanocomposites characteristic enhanced nanoparticles war composite protect metal component corrosive chemical condi ranted attention need paid raw material recycling sus tions like salt spray acid rain reducing maintenance cost com tainability study durability biocomposites multifunctional posites posse shape memory impact tolerance making composite show promise progress better characterization highly useful transportation aluminum based composite vehicle method simulation tool manufacturing process optimization economical fuel efficient lightweight steel iron essential essential evaluate environmental implication counterpart combining two metal component composite life cycle assessment collaboration across discipline tackle save weight resource setup composite ad intricate problem developing sector within path hesives coating mutually compatible offering additional benefit 8m bhong et al e r l p r c e e dingsxxx xxxx xxx due shared polymer composition composite excel insulator 12 raj p prajul r sridhar r pugazhenthig anbuchezhiyan ganesh maintaining form performance even low temperature investigating mechanical property tungsten carbide metal matrix composite al 6061 material today proceeding 2023 13 ostolaza j arrizubieta lamikiz plaza n ortega latest development composite open wide range new design option without manufacture metal matrix composite functionally graded material compromising performance strength state art review material 16 4 2023 1746 fiber reinforced composite ideal electronics due high 14 j cao f li q yang k e zhan z yang z wang b zhao review interfacial structure optimization mechanism property carbon reinforced resistance heat flame metal matrix composite compos interface 30 5 2023 543 583 innovative surface generation method provide post mold paint 15 k maurya g manik advance towards development industrially relevant short natural fiber reinforced hybridized polypropylene composite various finish without extensive time resource investment industrial application review j polym re 30 1 2023 47 biomaterials using composite heal damaged tissue serve 16 dinbandhu thakur venugopal goud e abhishek k vora j j 2021 replacement organ revolutionizing biomedical industry overview proteus world first man made non cuttable material recent aluminum based composite offer affordability fuel efficiency advance smart manufacturing material select proceeding icem 2020 95 102 lightweight property vehicle automobile part 17 etale j onyianta r turner j eichhorn cellulose review water composite reduce resource consumption compatible 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saxena deformation analysis al alloy aa2024 equal channel angular pressing aircraft structure adv mater process technol 8 1 2022 828 842 declaration competing interest 24 haleem shafiq q chen nazar comprehensive review adsorption photocatalytic chemical degradation dye nitro compound author declare known competing financial different kind porous composite material molecule 28 3 2023 1081 25 w zhang x x ji g emerging mxene cellulose composite design interest personal relationship could appeared influence strategy diverse application chem eng j 458 2023 141402 work reported paper 26 g korpi lu bramowicz arman kulesza b pszczolkowski gopikishan minkowski functional characterization fractal analysis surface titanium nitride film mater re express 6 8 2019 086463 data availability 27 k egbo fundamental review composite material application biomedical engineering j king saud univ eng sci 33 8 2021 data used research described article 557 568 28 awasthi k k saxena v arun sustainable smart 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zhang x ji l li synthesis expanded graphite based balasubramanian x p nguyen technical review composite phase change material application lithium based battery j storage mater 60 2023 material based secondary assisted battery thermal management system electric 106678 vehicle j clean prod 322 2021 129079 7 k zadafiya bandhu kumari chatterjee k abhishek recent trend 36 k k saxena lal comparative molecular dynamic simulation study drilling carbon fiber reinforced polymer cfrps state art review j manuf process 69 2021 47 68 vae cc ah na cn yi c da el f ep cr sp e pr rt oie c e c ear nb go n 3 8n n 2o 0t 1u 2b e 2 3w 4i 7th 2n 3u 5m 5 b er stone wale 8 h zhang z lin hu liang l ren l ren low voltage driven ionic 37 r mitran ionit ■ lincu berger c matei review composite phase polymer metal composite actuator structure material application adv change material based porous silica nanomaterials latent heat storage sci 10 10 2023 2206135 application molecule 26 1 2021 241 9 r laghari n jamil 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