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materialstoday proceedingsxxx xxxx xxx content list available sciencedirect material today proceeding journal homepage www elsevier com locate matpr critical review recent advance aerospace material rahul soni rajeev verma rajiv kumar garg varun sharma department industrial production engineering dr b r ambedkar national institute technology jalandhar 144027 india r c l e n f b r c keywords pursuit improved performance aerospace aviation industry inspired development aerospace investigation research advanced material since last year lot research different alloy aluminium alloy composite advanced material performed perfectly meet need aerospace titanium alloy field basic frame aircraft fuselage engine part wing etc various aluminium magnesium tita application nium nickel based alloy developed certain advantage like strength weight ratio corrosion resistance wear resistance etc however major challenge aerospace material insufficient mechanical chemical property overall weight aircraft fretting wear stress corrosion cracking incapability high temperature low oxidation resistance therefore vast study conducted development next generation aerospace material present article attention made study contemporary material current research going future trend advanced material field aerospace engineering aluminium based alloy found widely used metal alloy aerospace sector strong mechanical property however polymer matrix composite metal matrix composite gained popularity due exceptional strength stiffness titanium based alloy favoured strength corrosion resistance leading increased adoption 1 introduction aluminium alloy successfully used 80 year principal material structural component aeroplane 4 due article aerospace material structural component exemplary quality e admirable strength reduced used support load applied aircraft flight weight high corrosion resistance decent machinability well operation structural material used safety critical airframe benefit term cost compared steel titanium alloy component wing fuselage empennage landing gear tail boom aluminium alloy frequently used fabrication structural rotor blade helicopter well airframe skin element used defence automotive aerospace sector 5 thermal insulation tile spaceship like space shuttle 1 advanced aluminium alloy aerospace application momentum development aviation material accelerated required allow high fracture toughness higher fatigue perfor due way aerospace industry expanding primary mance high formability superplasticity meet demand motivating factor cost reduction via lighter construction longer reduced structural weight damage tolerance durability lasting aircraft part structure improved mechanical quality 6 due exceptional blend strength lightweight titanium material used make lightweight aircraft frame engine appeal aircraft designer due low machinability cause enhance payload extend flight range improve fuel efficiency e significant issue manufacturing 7 aerospace material titanium immediately lower aircraft operating cost 2 wooden alloy must viewed far modern superior steel airframe used first day flight 1903 marking aluminium alloy usa end 1940 first alloy beginning development aeroplane material developed among available alloy ti 6al 4v still dominates advancement cladding anodizing process 1927 present aerospace industry term application 8 recent aluminium based alloy took lead aircraft material 3 decade fabrication titanium alloy high strength abbreviation cfrp carbon fibre reinforced polymer cnt carbon nanotube hcp hexagonal close packing bcc body centred cubic ut ultimate tensile strength y yield strength cmc ceramic matrix composite mmc metal matrix composite pmc polymer matrix composite gnp graphene nanoplatelets corresponding author e mail address vermar nitj ac r verma http doi org 10 1016 j matpr 2023 08 108 received 28 may 2023 received revised form 9 august 2023 accepted 11 august 2023 2214 7853 copyright 2023elsevierltd allrightsreserved selectionandpeer reviewunderresponsibilityofthescientificcommitteeofthe7thinternational conferenceonproductionandindustrialengineering pleasecitethisarticleas rahulsonietal materialstoday proceeding http doi org 10 1016 j matpr 2023 08 108r soni et al e r l p r c e e dingsxxx xxxx xxx received great deal attention titanium community damage tolerance long term use environment high level theoretical research technological exploration produced moisture ultraviolet light extreme temperature 30 c 370 c several promising result 9 recent year cfrp composite e 14 carbon fiber reinforced polymer composite taken centre stage manufacturing aerospace energy storage equipment due 2 2 design requirement engine engine part benefit extremely strong lighter weight resistant corrosion 10 merging winding technique ultrasonic material aircraft engine part designed tow spreading technology carbon fibre reinforced epoxy composite way low density sufficient strength sustain mechanical various cnt content created particular cnt content thermal loading operating temperature different section discovered improve mechanical property epoxy resin aircraft engine range 300 c 600 c due high matrix significantly resulting structural functional integrated ultra operating temperature high engine speed maximum tangential thin cfrp composite application energy storage stress approximately 600 mpa induced rotor 15 aerospace 11 see fig 1 2 table 1 purpose presented article study recent 3 modern progress aerospace material vestigations conducted aerospace material contemporary research going view enhance property material alloy based aluminium 2000 7000 series well better durability economy article includes cost weight al li alloy main topic recent study even composite consideration material selection criterion selection material appear substantially replace aluminium based material still fuselage wing engine part followed modern progress several benefit including low cost simple manufacturing lighter aerospace material article also exhibit timeline aero weight high resistance sustain mechanical thermal space industry shift one another advanced material last loading section article future scope article presented al based alloy 2000 series typically alloyed cop per extensively researched material aeroplane 2 material selection criterion designing aircraft fuselage since outperform every series al based alloy term damage tolerance fatigue resistance 4 however due depending specific component consideration different relative weakness used area significant aircraft material different material property requirement level stress requirement design component condition appropriate fusion material sn cd ag loading ability manufactured geometrical restriction surface result material higher mechanical characteristic due finish ecological consideration ability maintained influence improvement microstructure grain size 17 reducing material selection aeroplane 13 number contaminant like fe si also improve mechanical quality 2 1 design criterion fuselage wing al based alloy 7000 range typically alloyed zinc element zn maximum solubility aluminium 31 6 aircraft component made material intended weight al zn based alloy employed skin upper wing last long time around 60 000 working hour strength material longerons vertical fin maximum strength weight two important consideration constructing wing compared al based alloy 4 unfortunately corro fuselage concept work material used airframe sion resistance fracture toughness damage tolerance alloy must lower density weight reduction suitable mechanical subpar quality application additionally material must adequate optimal fusion element zn mn result fig 1 schematic view cost weight consideration material selection 12 2r soni et al e r l p r c e e dingsxxx xxxx xxx fig 2 timeline history demonstrating introduction important material selection factor aeroplane design 1 excellent strength concerning weight improved table 1 resistance corrosion effective performance elevated temper different material used aerospace application 2 atures titanium based alloy gradually seen surge usage material application recent year serve component engine compressor heli copter rotor system aircraft spring α β α β titanium alloy 1 aluminium aluminium copper aircraft fuselage three category ti based alloy based alloy based alloy α titanium alloy crystal structure known hcp com aluminium zinc upper wing skin stringer parison β titanium alloy α titanium alloy le dense exhibit based alloy stabilizer aluminium lithium fuselage skin upper wing higher creep resistance exhibit better corrosion resistance α tita based alloy skin nium alloy commercially pure ti ti 3al 2 5v therefore 2 magnesium based alloy gearbox transmission utilized blade compressor aeroplane engine helicopter industry ever high temperature usefulness severely constrained al 3 titanium based alpha titanium disc blade compressor frequently employed enhance performance high temperature alloy alloy beta titanium alloy landing gearbox aircraft 22 aircraft spring application β titanium alloy crystal structure called bcc 4 composite ceramic matrix exhaust nozzle aircraft brake simpler produce tensile fatigue strength greater material composite material comparison α titanium alloy β stabilizer vanadium mo metal matrix fuselage skin wide body composite material wing lybdenum niobium chromium lessen beta titanium atomic polymer matrix fuselage aileron flap cluster binding energy resulting stronger bonding ti composite landing gear door alloying atom boosting alloy strength good example 5 steel gear bearing carriage β titanium alloy ti 3al 8v 6cr 4mo 4zr employed high fastener stress area aircraft like landing gear spring ut 6 nickel based superalloys combustor turbine section 1240 mpa 23 α β titanium alloy combine quality α titanium β tita improved mechanical characteristic instance adding mn 7000 nium alloy exceptional strength improved fracture series alloy 1 weight increase fracture toughness toughness good ductility better corrosion resistance account roughly 100 better mechanical quality also offered reducing 70 titanium market united state impurity like fe si 18 utilized ti based alloy ti 6al 4v α β alloy employed lightest weight among al based alloy al li based alloy fuselage landing gear floor support structure nacelle comparison alloy 2000 7000 series compressor disc among application 24 lower density good mechanical characteristic al li based alloy substance created two constituent material save weight 10 used place 2000 7000 referred composite material constituent material series alloy fuselage upper wing respectively 4 combined produce material characteristic distinct problem anisotropy fluctuation characteristic constituent part despite chemical physical quality different direction occur li al alloy additionally noticeably different according fig 3 airbus a380 us weak corrosion resistance low hardness 19 25 boeing 787 us 50 share composite addressing inadequacy recent study magnesium mg terials construction utilization material aircraft lightest structural metal use aerospace industry industry expanding since composite material le dense restricted although lower structure weight 33 77 metal enhanced strength weight ratio better respectively comparison aluminium steel volume resistance corrosion fatigue 20 inadequate mechanical characteristic cmcs composed ceramic fibre ceramic matrix even poor corrosion resistance mechanical quality alloy based 1400 c cmcs maintain good high temperature stability also magnesium enhanced adding right amount aluminium excellent hardness robust corrosion resistance example zinc zirconium rare earth metal like yttrium corrosion resistance include silicon nitride si3n4 silicon carbide sic alumina improved using al additionally strength ductility thus commonly used hotspot like exhaust nozzle 25 mg al alloy improved adding zinc critical level 5 wt cmcs however weak fracture toughness current research mixing mg zn zr greatly increase strength absence concentrated using gnp cnts increase fracture toughness al instance mg97zn1y2 alloy based magnesium cmcs according scientific test adding 1 5 vol graphene maximum strength yield strength 610 mpa 21 raise fracture toughness si3n4 235 26 3r soni et al e r l p r c e e dingsxxx xxxx xxx fig 3 material used boing 787 16 mmcs reinforcing element spread throughout metal matrix based alloy due low ductility abundance attractive mmcs improved wear resistance lower thermal expansion higher candidate various application use top aircraft manu yield strength fracture toughness matrix metal facturers limited due poor corrosion resistance ti based aluminium magnesium titanium copper nickel employed alloy acknowledged high specific strength corrosion glass carbon fibre two type regularly utilized reinforcement resistance use increased recent year material however fibre already provided everything α phase alloy greatly limit capability higher tem capable achieve better mechanical quality novel material peratures metal alloy super alloy composite available including cnts graphene nanosheets research previous literature majorly better quality lag regulated inclusion cnts reported enhance mechan required quality therefore investigation research ical characteristic ut y hardness aluminium required conducted enhance property material magnesium titanium copper nickel matrix composite 27 greater extent pmcs type composite material made several short continuous fibre joined organic polymer matrix commonly used 4 conclusion future trend fibre include aramid graphite fibreglass pmcs divided two category thermoset heat remoulded ther aircraft sector undoubtedly advanced significantly moplastic depending property polymer matrix past century large portion development attributed heat remoulded epoxy polyurethane polyamide advancement innovation structural engine material thermoset matrix frequently used create pmcs aerospace foundation present aerospace engineering high sector employed aileron hinged flight control surface performance alloy based aluminium magnesium titanium flap ahigh lift deviceconsisting hinged panel panel mounted nickel along composite material still deal several trailing edge wing landing gear door 28 problem corrosion stress corrosion cracking fretting wear etc greater specific strength specific modulus pmcs well therefore increase safety effectiveness affordability air recognized instance density carbon fibre reinforced alloy travel substantial focus given research new aerospace epoxy matrix binder half alloy based aluminium material next generation higher mechanical quality modulus elasticity tensile strength two three time better corrosion resistance future airframe structure alloy based aluminium respectively however development new aerospace alloy composite high specific since fragile carbon fibre vulnerable stress concentra mechanical property refined microstructure thermo tion currently basalt carbon nanotube graphene natural fi mechanical processing major concern however engine bres studied reinforcing element polymer matrix part improvement high temperature resistance high 29 temperature oxidation resistance higher fracture toughness low specific strength resistance corrosion steel dras primary concern tically reduced utilization aircraft sector recent year due higher density mild steel comparatively high ut 840 mpa credit authorship contribution statement unique feature make unsuitable use aircraft however continues crucial component fastener carriage bear rahul soni rajeev verma rajiv kumar garg supervision ings enhanced particular characteristic corrosion resistance varun sharma supervision conceptualization new low alloy steel nano steel investigated 30 superalloys based nickel extremely strong even high declaration competing interest working temperature result frequently employed turbine combustion chamber aircraft engine oper author declare known competing financial ating temperature vary 1100 1250 c 31 two interest personal relationship could appeared influence widely used ni based superalloys inconel nimonic increase work reported paper resistance oxidation ni based superalloys al added 32 literature suggests due well known mechanical property data availability al based alloy primary material aerospace industry use pmcs amplified recent year data made available request excellent specific strength stiffness however conventional pmcs mmcs known suffer stress corrosion cracking mg 4r soni et al e r l p r c e e dingsxxx xxxx xxx reference 18 w nam h lee effect mn mechanical behavior al alloy met mater int 6 1 2000 13 16 http doi org 10 1007 bf03026339 19 kalyanam j beaudoin r h dodds f barlat delamination cracking 1 p oxford introduction aerospace material woodhead publishing advanced aluminum lithium alloy experimental computational study eng material 2012 2 x zhang chen j hu recent advance development aerospace fract mech 76 14 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