# Load PVDF nylon Non-woven fabric intercalation carbon fiber / Epoxy resin composite

**Study on the damping property of structure**

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***Abstract:*** with load quantitative polyvinylidene fluoride ( PVDF ) nylon non-woven fabric for intercalation materials , carbon fiber reinforced ring prepared by co-curing process gas resin base composites , The mechanical and damping properties of the system are systematically studied . tests the flexural strength of composites , bending modulus , layer Shear Strength , I type and n type fracture toughness and other mechanical properties , and tests the energy storage modulus of the composite through a dynamic mechanical analyzer , loss modulus and loss factor temperature spectra , the damping and vibration resistance of a single cantilever beam is studied by free vibration experiment. . at the same time , analysis using optical microscopy and scanning electron microscopy composite microstructure , and then study damping mechanism . The results indicate that , Insert load between composite layers PVDF the nylon non-woven fabric of can be in no causes significantly reduced mechanical performance , The damping properties and fracture toughness of the composites are improved significantly . The Basic damping mechanism of is that it has been cured in a total of The thermoplastic intercalation material in the process forms a resin-rich area with a high loss factor between the layers of the composites , increase the loss factor 150%, and Force basic performance remains unchanged.
***Keywords:*** Structural damping composites , dissipation factor , PVDF , nylon nonwoven , off-position toughening

In recent years with aerospace precision instruments and intelligent equipment requires higher ambient vibration control , traditional viscoelasticity damping material due to low mechanical strength , Easy aging Failure and issues such as split hierarchies gradually fail to satisfy requirements . using a solid Synthesis of structural damping integration composite can overcome Free damping treatment or constraint resistance using traditional viscoelastic materials to deal with structural dimensions , Space and weight Many factors restrictions , not easy to split hierarchies , and its best advantage is knot construct load and damping capability , to achieve material structure workintegration [2] .

The most recent research is to add high impedance between composite layers The viscoelastic material preparation of the co-curing structural damping composites , but the elastic modulus of viscoelastic material and the glass transition temperature are universal Lower , damping performance affected by temperature and frequency , and the tree The binding of the lipid matrix is poor , These factors cause the co-curing complex the mechanical properties and damping effects of materials are worse than expected.Dob . . so , developing new intercalation materials Only ~ and introducing a new damping energy dissipation mechanism °^ % for curing composite materials ready to get People's attention .

Zhangpeng [027] research finds high porosity nylon nonwovens as a structural toughening layer to cross-layer thermosetting resins Mutual penetration wear , The forms a_ A non-reactive two-phase structure and table Show significant toughening effects , and in-Plane mechanics of composites performance has no significant effect . also , Liao, and so on

[028] research finds hot plastic polymer polyethylene - acrylic fiber insert INTO layer , through The ultrasonic heating causes it to melt and fill into the damaged composite gap inside and inherent defects , can act as an enhancement . Is inspired by this , in consider thermoplastic with high damping and impact resistance in this articlePolyvinylidene fluoride (poly ( Vinylidene fluoride) , PVDF ) load onto nylon non-woven fabric and prepare as intercalation material co-curable composites , through thermoplastic resin molecular chain in structure Damping performance of the system by friction energy dissipation in vibration process , through over-thermosetting matrix resin through the slit-shaped pores of nylon non-woven fabrics Double continuous phase structure to ensure mechanical properties of composites , Pass over PVDF melting during preparation - recrystallization process fill Possible defects and gaps in composite materials , further change good mechanical properties of composite materials , is structural damping _ body Material Preparation offers _ new design ideas .

# 1. Experiment Section

## 1.1 Experimental raw material

nylon nonwoven ( polyamide nonwoven fabrics , PNF ), fiber diameter approximately 0 pm , face density 0 $g/m^2$ . Poly polyvinylidene fluoride , purchased from Shanghai Tri-Love company , grade FR904. T 800/5228 Pre-leaching , Beijing Aeronautical Materials Research Institute self -made.

## 1.2 preparation of structural damping materials

First in the PNF Load PVDF , The amount of the load is 0 g /

$m^2$ , The Load method is to use two methyl formamide to dissolve the quantitative PVDF Direct paint to PNF . and then load PVDF for PNF for inserts , T 800/5228 Prepreg for the structure layer follow the diagram 1 and Table 1 The paving layer is prepared by the for a eutectic composite . solidify system heats up for edge vacuum edge to ° ° C ,and then press the pressure tank to 0.6 MPa ; continues to warm up to 180 ° C , maintain temperature and pressure 2 H ; to cool down to C The following , release pressure ,To Remove the try item . . the rate at which the temperature rises is 1. 0 ~ 5 K/ min

## 1.3 test Representation

test of static mechanical properties of composites in Instron 8803 on the material tester . flexural Performance test specimen size to mm X , 5 mm , with a thickness of stepover Times , test Mark astmd790. interlaminar Shear Strength test specimen size is MMX 6 mm , Test standard is ASTM 2344 , span to thickness 4 times to 5 Times . I -interlayer fracture toughness $6_{1\ (:}$ by standard HB 7402-J6 test ,II type interlayer fracture toughness $G_{IIC}$ Press Standard HB740346 test .

test of dynamic mechanical properties of composites in the United States TA Public Division production dynamic Mechanical Analyzer (DMA Qon. . Test mode is three-point bent , sample size is mm X ten mm , Its beam stepover is mm . Test Frequency 1 Hz , temperature range ~250 ° C , warming rate 3 K / min , The strain size remains in the0. 015%.

damping properties of composite materials using single cantilever beam vibration experiment evaluation . sample size is 180 mm X , mm, Cantilever length 130 mm, Use the change curve of displacement over time to obtain a composite material material dissipation factor , The test device is a laser vibration Finder Polytec -

PSV B .

to load PVDF Nylon Non-woven fabrics for and I type fracture toughness Composite cross section , with model qunatascanning electron microscopy for microscopic characterization .

# 2. Results and discussions

## 2.1 Mechanical properties of composites

Mechanics of traditional viscoelastic composite materials at ambient temperature performance loss up to 60% above [515] , Although through the viscoelastic the cross-linked network that forms the matrix resin on the material can be improved altogether Mechanical properties of solidified composites , but flexural strength and modulusThe amount of loss still exceeds 40% [M] . This article takes a crystalline hot Plastic Polymers PVDF load high porosity PNF as intercalation material preparation of structural damping composites , first on a compound Static mechanical properties of materials , including flexural strength and modulus, and layer The shear strength between is tested , followed by DMA Experiment with duplicate Evaluation of the dynamic mechanical properties of the materials , also studied composite material fracture toughness ,And through the mechanical properties of several control groups and micro-topography contrast the toughening mechanism of the .

## 2.1.1 static mechanical properties of composites

Table 2 lists the load PVDF for PNF co-curing structural resistance composite flexural strength , bending modulus and interlaminar shearing strong degree test results . An empty composite with no intercalation on it flexure strength 2260. 4 MPa , The bending modulus is 151. 2 GPa, Fiber dimension volume marks 50%, thickness is about 1. mm. .co-solidify The thickness of the composite increases with the number of inserts. , But the increase is gradually decreasing . inserts A 1 layer Load PVDF for PNF when , the thickness of the composite is increased pm , and insert 7 layer increases only 440 pm , This indicates that the number of different intercalation pairs is solid The structure of the composite has different effects . increases with sample thickness , carbon fiber volume fraction decreasing , bending modulus also decreases , but down to a lesser extent, add 7 layer load PVDF PNF when , flexural strength and flexural modulus are respectively 1712. 1 MPa and 128. 6 GPa , The decrease of the blank sample is, respectively A . 2%and 9%. also , interlayer of a blank sample without intercalation cut strength 111.8 MPa , co-curing composite layer between layers The shear strength decreases with the increase in the number of inserted layers , where Insert 1 layer load PVDF the layer Shears for the composite of the PNF cut strength to 104.8 MPa , lower than blank sample 6.3, and insert 7 Layer , layer shear strength down to . 0 MPa , down to 1%. to bend properties and layers of composites between shear strength divided by carbon fiber volume score _ Turn curvature performance and Interlaminar shear strength , Load PVDF Nylon Non-woven for the flexural modulus and Interlaminar shear strength of a fabric-cured composite are higher than blank sample , Bend strength slightly down , But the drop is very small . To summarize , loads PVDF nylon Non-woven fabric insert between layerspreparing a co-cured composite does not cause its flexural strength , Bend large drop in modulus and Interlaminar shear strength .

## 2.1.2 composite Dynamic mechanical Properties

diagram 2 is a load PVDF for PNF intercalation co-curing composite material material loss modulus and storage modulus DMA test results . consists of the Chart 2(a ) know , loss modulus of blank composites with temperature elevation increasing , Peak value in 223. 6 °c, about 0 GPa. The loss modulus of a co-cured composite is in °c The middle and low temperature range of is always higher than the blank sample , , which indicates that its has better medium and low temperature loss performance . where is inserted1 layer Load PVDF , PNF when , maximum loss modulus at room temperature and 213.6 C up peak 3 GPa,, higher than blank sample about 117. 0, and insert 3 layer and 7 Layer, peak of dissipation peak value and corresponding temperature significantly drop , but in 0 ~ 0 C for The loss modulus in the low temperature interval of the appears to increase significantly first and then minus fewer trends and a . 6 C A lossy peak occurred when . As shown in figure 2 (b) shows , The energy storage modulus decreases with increasing number of insertion layers , Inserts into the 1 layer close to blank sample , about 133.6 GPa , and insert , 7 layer now down to 108.9 GPa , drops lower than blank sample for ? 5%. This and the static mechanical properties of the test results basic Kiss . . It is worth noting that , The energy storage modulus of a co-cured composite withthe mode of temperature drop is larger than blank samples , and insert the the number of more layers , Greater Change . blank sample in 210.4 C before storing The modulus is basically unchanged , more quickly drop to . GPa. and a common-cured composite appears with 3 descent phase , with Example of insert 7 layer , save modulus in 167. 7 Cbefore you slow down drop after , drop speed Increase , When temperature rises to 176.4 C after quickly drop to Ten.

0 GPa about . Why , As shown in figure 3 PVDF DSC curve shows ,PVDF on 170 C Show Melt fused endothermic peaks , co-curing composites due to PVDF on 170. 0 C A melting near the occurred with a premature drop in the energy storage modulus , this The describes its heat resistance. PVDF Melting temperature limit , so contains PVDF for use as structural material The use temperature of the must be limited to . 0 C The following .

### 2.1.3 interlayer fracture toughness of composites

Table 3 The lists the layer-free composites and inserts the between the layers into nylon non-woven fabric and load PVDF nylon nonwoven composite material I type andII test results for type fracture toughness . Blank compound material $G_{IC}$ for 306. 0 j/m $^2$ , $G_{IIC}$ is 718. 0 j/m $^2$ . between Layers add nylon nonwoven after $G_{IC}$ increase to 574. 0j/m $^2$ , The improves the about 88%, G IK Improve to 3144. 0 j/m $^2$ , To improve near 3. 4 times , toughening obvious . The toughening mechanism of the is that the benefit of the small sue proposed by the position increase toughness [2] .
SEM Photo . As shown in figure 4 (a) ~4 (e) : , nylon nonwoven fabric A large number of voids can be filled in by the matrix epoxy in the curing process to form a non-reactive dual continuum Phase structure [127] . opens load action , as shown in the black arrows in the picture , nylon nonwoven fabric pull out from the epoxy matrix , , plastic deformation , break shape The cracking energy of the absorption crack extension , In addition to the nylon fiber's pull-out also causes the surrounding epoxy matrix to deform thereby absorbs _ part of energy plays a role in blocking crack propagation . and load PVDF for PNF intercalation of a composite of the $G_k$ up to

to 1700.0 J/"m $^2$, more blank composites improved 4.6 times ,$G_{IK}$ reached 2829. 0 J/[]m $^2$, higher than blank composites 2 . The Times , This indicates that the load on the nylon Non-woven fabric is PVDF to further improve composite's I layer break toughness . diagram 4(1) indicates that , PVDF is more evenly loaded in nylon The surface of the non-woven fabric and not fully cover the void on its surface , ring the oxygen resin is still able to fill part of the nonwoven during curing To form a double continuous phase structure . As shown in figure 4 (h) ~4 (k) Show ,Gic The cross-section not only appears the pull-out of nylon non-woven fabrics , Plastic warp and fracture , on nylon nonwoven and matrix resin surfaces also the appears with a lot of slice breaks. PVDF Film , as shown in the white color arrows . PVDF The melting point of the is 170.9° C , and solidify Composite Curing temperature 180.0°C , This means that during the Molding Process PVDF undergo a process of melting recrystallization , under molding pressure,PNF surface Load PVDF to can penetrate the gap between the matrix resins and after the temperature is lowered The new crystallization forms a certain interface interlock structure , and PVDF due to is a semi-crystalline material , has good mechanical strength and impact resistance can , During crack propagation , PVDF through its own crystal area damage to the structure and plastic deformation of the amorphous zone and rupture absorption A lot of energy , to go _ steps improve the interlayer of the compositefracture toughness .

Table 3 Interlaminar Fracture toughness measurement results of cocuredcomposites with different interlayers </ b12

2.2 Damping properties of composites

The current damping characterization methods for damping materials are mainly : Damping more 6 dissipation factor N ,, logarithmic decay rate 5 etc , its calculated formula like under :

$P_{i+1}$, is the first N +1 and N Peak Oscillation for cycles . Uniform Vibration Attenuation in the calculation of this article 0. 8 ~ 1. 8 s all in The average value of the logarithmic decay rate computed for the adjacent period is the attenuation rate of the number for the .

The loss factor for the sample is 0. 0048, and add l Layer load PVDF PNF co-curing composite loss factor reached 0.0065, Improved on a blank sample . 6; inserts A 3 Layer loss factor is 0.0063, is slightly lower than insert 1 layer composite material dissipation factor ; inserts A 7 loss factor for composites at Layer reached 0. 0121, improves than blank composites 152. 1%, but less than insert 1 that increases the loss factor at the layer 7 Times , this also describes the number of intercalation materials , Its distribution location to composite the loss factor for the material also has a significant effect. .

diagram 5 (b) is a load PVDF the nylon Non-woven fabric intercalation of is total curing composite loss factor - temperature spectral curve . Visible , No Insert Composite in 150.0°C The dynamic loss factor before is approximately 0. 0100, dissipation factor peak and glass transition temperature respectively 0.2598 and 229.0 C. inserts a load of different layers PVDF for PNF after , The loss factor for the composite is significantly greater than the blank sample Increase , and 150.0 C medium and low temperature segments before with number of layers The increase in increases gradually , and C appears around 1 lossy Factor Peak , at this time 7 layer Load PVDF for PNF co-solidifyComposite dynamic loss factor is higher than blank sample approximately 0. 0075. also , as the number of inserts is increased , Composite glass transition temperature decreasing but loss factor peak gradually Improve .

To summarize , Insert load between composite layers PVDF for nylon Non-woven fabric can significantly increase its damping vibration in wide temperature area can , The has a significant increase in the number and position of layers affect .

## 2.3 Structural analysis of composites

is known from the above analysis , Load PVDF nylon nonwoven for
intercalation of common-cured composites by sacrificing less dynamic and static Mechanical Properties obtain a clear reference to damping performance and fracture toughness high . This article on the load PVDF the nylon Non-woven fabric intercalation of is cured altogether composite structure Analysis , Find out its mechanical properties and structural basis and microscopic mechanism of damping performance , For through the knot Construction design and material modification further improve structural damping composites provides a basis for damping and mechanical properties .

diagram 6 is a load PVDF for PNF intercalation co-curing composite material material side optical microscope photos . where , no intercalation composites the Resin interface layer of the is very thin , about 2 ~3 pm , carbon fiber throughout the complex Distribute more evenly across the material . and insert the payload PVDF for
nylon Non-woven fabric will be formed in the insertion area _ layer rich with fixed thickness resin area : insert 1 layer , layer thickness (65±10) pm; Inserts The greater , The thickness difference between the layer-rich zone is the more obvious the , ; Inserts into 7 layer , between the thickest layers of pm , and the thinnest layer have only pm , The porosity of the different parts of the non-woven fabric is slightly different and the There is a difference in the number of PVDF of the, resulting load to the matrix epoxy enter the number of Non-woven gaps , causes the thickness of the resin-rich zone to exist _ difference , but The ultrasound scan results show that this thickness difference does not cause the composite The material internally produces obvious defects .

Load PVDF nylon Non-woven fabric intercalation composite material material structurally equivalent carbon fiber layer and interlayer rich resin zone structure for laminated composites , as shown 7 show , Carbon fiber layer stiffness far greater than layer rich-resin area , and loss factor exactly the opposite , entire total cured composites made up of " hard - on" - more The microstructure of the , class like traditional constraint damping processing structure . loss of carbon fiber layer

factor Low , primarily provides constraints and force-passing effects , the rich resin in the middle of layer dissipation factor large , is main damping source of energy . inter-layer rich tree The Properties of the cured composite, especially the damping properties, have the Important Effects , necessary for its mechanical properties and dampingenables in-depth research .

so , The matrix resin was prepared by 5228 and PNF and negative Download PVDF PNF Enhanced resin casting and dynamic mechanical performance test , results are shown in **Figure 8** shows . is below C for temperature range , load PVDF for PNF Enhanced Epoxy cast body dissipation factor maximum , and 9 C and A . 0 C out now two loss

factor peaks , Peak value 0. 0650 and 0. 4200, divide At the same temperature pure 5228 The loss factor of the resin increased about 160% and 123%. and more than C after ,Pure epoxy into into the glass transition zone , loss factor rapid rise , Peak and corresponding temperature is 1. 1007 and 214.2 C , at this time PNF and PVDF but will hinder the molecular chain movement of epoxy resins , thereby reduced loss factor . diagram 8 (b) is a stored energy model for different castable bodies
temperature Spectra of quantities , Load PVDF for PNF Enhanced Epoxy tree The initial storage modulus of the grease cast reaches 2750 MPa , more than pure epoxy 5228 is higher than 560 MPa , and with the temperature l „ The storage modulus decreases and is clearly divided into three phases : page _ phase from room temperature to + C,drop rate faster than pure epoxy and PNF Enhanced Casting bodies , storage modulus dropped to 2140 MPa is flat with pure resin ; continue to raise the temperature , The next of its storage modulus drop down speed to second stage , When temperature rises to 162 C , the storage modulus drops to 1106 MPa and start again quickly underDrop , now PVDF because it is close to its melting temperature 170. 9 C no start melting , and nylon non-woven fabric melting temperature reaches for, C , The temperature resistance of the castable is significantly higher .

is due to a load of PVDF PNF rich Tree the lipid storage modulus decreases faster than pure epoxy . , guide for PNF The energy storage modulus of the intercalation co-curing composite decreases faster than no intercalation composites , and glass transition temperature also in advance ° ° C around .

It is worth noting that , inserts A 7 layer Load PVDF for PNF after , 7 the thickness sum of the layer-rich resin layer reaches the pm above , and the total thickness of the composite is only increased by 440 pm , this indicates that the resin thickness in the carbon fiber layer is compressed. , as shown the optical microscope photos in the 6 (3#)are shown in the photo of the light microscopy . due to carbon fiber layer inner thickness , its fiber volume fraction is greater than blank composite materials , theoretically higher mechanical properties . for inserting 7 layer Load PVDF for PNF co-curing composites , Is rich across layers resin area modulus higher than pure epoxy modulus , and carbon layer again has high mechanical properties , Therefore, the bending modulus is only reduced by the . 9%, is less than its carbon fiber volume fraction drop value 20%.

Composite when bending vibration is deformed under external load , the upper and lower surfaces loop under compression stress . and tensile stress ^, The Middle part is under the opposite direction on the top of the
extra Bear _ Fixed shear stress , based on the figure 7 for the middle-tier panel Shear Stress distribution Formula know , neutral face shear stress maximum . Literature Report, structural loss for flexural constrained damping structures factor and constraint layer stiffness and damping layer and constraint layer thickness ratio and the damping layer loss factor is proportional to The, and damping layer clipping mode is inversely proportional to I . inserts A 1 layer Load PVDF for PNF , Rich resin area is in neutral position ,subject to maximum shearing stress , pass all thermoplastic polymers with non-woven fabrics and their loads PVDF non-crystallization The movement of the zone segments and the friction of different interfaces can consume more Energy from the, thereby increasing the loss factor for composites . and insert 3 layer Load PVDF for PNF , As shown in figure 7 shows , Middle Tree rich The sides of the lipid layer can be equivalent to the internal contains 1 layer rich resin layer Sub-laminated board , only thickness &compared to h Increasing and modulus is small , This is The damping loss of the resin-rich zone in the neutral surface is weakened. , But because of the damping effect of the upper and lower laminated plates. , fully To result in the loss of a common-cured composite that inserts the 3 Child with insert 1 layer basic equivalent . inserts A 7 layer LoadPVDF for PNF , The sides of the resin-rich layer can be considered internal each containing 3 equivalent sub-laminates of layer-rich resin layer , only thickness $h_7$

in _ Step larger , and modulo _ Step Decrease , So the neutral surface is rich The damping effect of the resin zone into the the _ step weaken , But because of the child laminated The volume fraction of the carbon fiber layer in the increases , , thickness decrease cause it the Internal resin-rich zone's damping effect is increased , So insert 7layer load PNF The loss factor for has a significant growth , no Greater than 1 86.0%, This further confirms that the Neutral layer resin-rich zone energy loss due to shear stress The entire laminated plate structure loss factor proportion maximum [M] .

## 2.4 Balanced optimization of mechanical and damping properties of composites

Depending on the elastic modulus and damping performance of the material, you can divides traditional material into 4 class : (1) Metallic materials and ceramicproducts material , High modulus of elasticity but low loss factor ;(2) rubber material , High loss factor but small modulus of elasticity "3" project hard Plastic , has a relatively high modulus of elasticity and loss factor ; (4) resin matrix composites , has a higher modulus of elasticity and a slightly lower dissipation factor . Many practical engineering applications hope that the material can be enough for high mechanical performance and damping loss performance , This is also the knot Development direction of composite damping composites . is currently , structure damping compound The study of the material is mainly to apply viscoelastic oak with high dissipation factor Glue material is cured to polymer matrix composites , Though structure The loss factor for is significantly increased , But the mechanical properties of the material are down at least than 40%, and temperature-resistant performance is much worse . Lakes propose product of modulus of elasticity and dissipation factor of material good value Merit ""to evaluate material balance mechanical properties and damping effects The ability of , to Increase the stiffness of the damping phase is to obtain both damping effective ways of damping and mechanical properties of composite materials , and set has a single W4 N Sn alloy , its modulus of elasticity is up to GPa , has more than 0.1000 loss factor for , but for the preparation of this material has not yet been seen _ Step Coverage [8] .

This article uses a thermoplastic PVDF load on nylon non-woven fabric for to prepare a curing composite for intercalation materials , through in composite material The layers of the material form a damp-rich resin layer , without mass sacrifice under the premise of structural mechanics performance a significant increase in the composite'sDamping Performance . the uses the bending modulus and the free vibration attenuation curve to be structural loss factor calculated with calculation of optimal values ,results as shown 9 is shown . to See , insert 7 layer Load PVDF for PNF intercalation co-hardening compound material Best value , reached 1.6 GPa, about blank Samples value0. 7 GPa for 2. 3 times , This shows that by using the to composite A nylon nonwoven fabric with layer Insert load PVDF can improve composite compatibility of materials with mechanical and damping properties .

# 3. Conclusion

Insert Load PVDF the nylon non-woven fabric of the causes a co-curing complex The bending properties and Interlaminar shear strength of the composite materials have a certain degree of

Drop , inserts A 1 layer and 3 The layer decreases by a significant , about 6.0 ~ 8. 0%. inserts A 7 Maximum bending modulus decrease at layer , is approximately a . 9%,interlaminar shear strength down about . 1%.

Insert Load PVDF the nylon non-woven fabric of is significantly improved by a total of Curing composite Vibration attenuation performance , Insert 1 layer and 3 Layer ,loss factor is not significantly different , increases the range of blank samples approximately 30%. inserts A 7 layer Loss factor reaches 0. 0121, ratio blank samples increased152. 1%.

To add load between layers PVDF the nylon non-woven fabric of is significantly High interlayer fracture toughness of composites , its $G_{IC}$ and $G_{IIC}$ reach 1700. 0 j/m $^2$ and2829. 0 j/m$^2$ , more blank sample mention high 4.6 times and 2.9 times .

Insert Load PVDF the nylon non-woven fabric of enables the curing of a composite structure of material changed , layer out average about pm rich resin with a thick and low modulus of elasticity and a higher loss factor layer , forms a structure similar to constrained damping processing . inserts A 1 Layer when , Rich-resin zone is the largest in the composite's neutral face Shear stress , damping obvious . and insert 3 layer and 7 Layer when , neutral surface resin-rich layer's damping effect due to its equivalent constraint layer thickening and decrease of stiffness decreased , But the composite material as a whole structural loss factor through increased damping loss of the resin-rich layer is made up for further improvement .

The value reflects the damping and mechanical properties of the material. Ability , insert 7 layer load PVDF ( PNF co-curable complex Combined material's excellent value reached 1. 6 GPa , is approximately blank sample value , 2. 3 Times , This means inserting a load through the composite layers A nylon Non-woven fabric with PVDF "" can improve material to mechanical properties and Balancing of damping performance .

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