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Fiber Surface Modified Composite Material with Dielectric Properties for Sports Equipment

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Abstract: Fiber surface modification refers to the process of performing special chemical or physical treatment on the fiber surface to make it have the required performance or function. Composite materials refer to new materials artificially combining materials with different properties. The combined materials must be two or more than two, and the new materials formed by the combination have obvious interfaces. With the continuous advancement of science and technology, the economic level of sports has also been greatly improved, and more and more people have realized the importance of sports equipment in sports. This article aims to study the relationship between sports equipment with dielectric properties and fiber surface modified composite materials. This paper proposes the use of alkali treatment and plasma treatment for surface modification of fibres, the fibres before and after treatment as reinforcement for the matrix, and the preparation of composites by vacuum infusion moulding process to analyse the surface changes of fibres. Through the analysis of fiber materials, it is found that it can be applied to the field of sports equipment including graphene rubber composite materials. The experimental results in this article show that when 50% rubber is added, the thermal decomposition temperature is 400℃, and the thermal decomposition temperature is increased by 35%. When 1.2g of material is added, the tear strength of the rubber composite is increased by 78%. , When 1.1g of material is added, the tensile strength of rubber composite is increased by 161%. When 1g of material is added, the tensile strength of rubber composite is increased by 73%. When 0.5g of material is added, rubber composite the tensile strength of the material has increased by 43%.

1. Introduction

1.1. Background

As China's economy continues to take off, it has promoted the development of all fields of society, and China's sports field has also been fully developed. Technology is the foundation of a country’s prosperity, and innovation is the soul of national progress. As China moves from a sports power to a sports power, sports equipment must be upgraded, the strategic adjustment of the sports industry structure must be vigorously promoted, and modern smart technology will be applied to sports equipment. In recent years equipment and technology have become increasingly important in the field of sport, especially in the traditional sporting powers which have introduced new techniques and equipment into sport. And this combination has become a major focus of research in sports science. In recent years, equipment and technology have increasingly occupied an important position in the field of sports. In particular, traditional sports powers have applied new technologies and new equipment to sports. This combination has also become a key research in sports science. With the continued prevalence of Olympic events, the combination of scientific and technological achievements and sports events has become an unstoppable trend. However, through research, it is found that the sports equipment used in major international events is dominated by foreign brands, while the training equipment used in China is also dominated by foreign products. There is few high-quality sports equipment in China. The logistics of sports training has always been limited to foreign brands, which is very detrimental to Chinese sports training. In addition, with the development of the times, sport has become a sport that the public is exposed to. Therefore, new technologies and materials are used to create new types of sports. Sports equipment has become a top priority. Discussing the relationship between sports equipment with dielectric properties and fiber surface modified composite materials will help promote the development of local sports.

1.2. Significance

After innovating the materials of sports equipment, this article fills up the current local deficiencies in the development of smart sports, promotes the further development of sports equipment, provides a material basis for scientific sports training, responds to the country’s call for a "sports powerhouse", and is driven by innovation. Develop, improve the competitive advantage of local sports equipment, and break the foreign monopoly on sports equipment.

1.3. Related Work

With the continuous improvement of economic living standards, people's needs for daily life are no longer limited to material aspects, and they are beginning to pursue all-round development. Sports have become the embodiment of the current high level. But nowadays, many sports equipment cannot meet the demand, and the use of new materials and new technologies to develop new sports equipment has become the best choice. Ruan K proposed a humanized design method for human-adaptive sports equipment. According to the theoretical knowledge of ergonomics, physiology, and psychology, carry out the humanized design of human adaptive sports equipment, and use the theoretical knowledge of modeling, color, material science and other related disciplines to address the ambiguity of human adaptation to the industrial design of sports equipment. Fuzzy mathematics theory is an analysis tool, combined with the actual characteristics of people adapting to the industrial design of sports equipment, focusing on the essence of industrial design under fuzzy theory. Comprehensive analysis to understand design-related factors and the introduction of expert survey methods to derive weighting values for single-factor influences in the absence of basic data sources for innovative design helps designers to grasp the main contradictions and achieve targeted, more efficient solutions to key problems [1].Liu A proposed a fault detection technology for traditional national sports equipment based on optical microscope imaging technology. Integrate the concept of confocal fluorescence into the imaging system of the optical microscope to improve the axial resolution of the optical microscope and enhance its microscopic imaging effect; collect the microscopic images of traditional ethnic sports equipment, and use the mean filter method to analyze the collected traditional ethnic sports equipment The microscopic image is denoised, and the denoised phase image is processed based on the error correction algorithm, and the denoised phase image is merged to construct a trouble-free standard background image, and calculate the average gray value of all pixels in the micro image. If the gray value of the pixel is higher than the confidence interval, it is determined that there is a fault. The test results show that the proposed technology can meet the test of equipment [2]. Pasha A reports on the conductivity enhancement and dielectric parameters of PEDOT-PSS transparent films prepared using DMSO as an organic solvent. It is well known that PEDOT-PSS dispersed in an aqueous solution has very low conductivity, which hinders its application as a transparent electronic material. The structural properties of the prepared films were studied by scanning electron microscopy, ultraviolet-visible spectroscopy and infrared spectroscopy. SEM studies of these films show that islands of particles are formed in the composite film. The FTIR spectrum of DMSO in PEDOT-PSS shows that, compared with the original PEDOT-PSS, as the peak intensity decreases, the characteristic peaks move at higher wave numbers. Studies have shown that PEDOT-PSS doped with DMSO has obvious absorption near 500-700 nm in the NIR range [3]. Hung P Y highlights the importance of using GRMs to enhance the performance of CFRPs. Graphene-related materials (GRMs) have been identified as excellent nano-reinforcements for carbon fibre reinforced polymers (CFRPs) with a wide range of engineering applications.GRMs are easily produced from their primary source, graphite, which is relatively cheap and available in large quantities worldwide.The excellent properties of GRMs, such as large surface area, high mechanical strength and low manufacturing cost, make them outstanding nano reinforcements to form multifunctional and multi-scale composites Different synthetic methods for depositing GRMs on carbon fibre surfaces and their effectiveness in improving the properties of the host material are reviewed and discussed. At this stage, more work is still needed to understand the underlying stress transfer mechanisms in GRM-coated CF composites. Their enhanced performance in low temperature environments is essential for the development of new aircraft and space engineering [4]. Gadzama S W proposed the influence of chemical treatment with sodium hydroxide (NaOH) solution, zinc chloride, acetic anhydride and nitric acid on the mechanical properties of pineapple leaf fiber reinforced polypropylene composites. Pineapple leaf fiber (PALF) is a natural fiber with high industrial potential. Natural fibers have become the main alternative source of reinforced polymer composites. Tensile test is performed by using ASTM D638-10 to obtain tensile strength (TS) and Young's modulus (YM), and bending performance is performed to determine the flexural strength (FS) and flexural modulus (FM) of reinforced composites. Use ASTM D256-10 method, and use the Izod ASTM D790-17 method to conduct an impact test to determine the impact strength (IS) of the reinforced composite. From the results obtained, the surface-modified PALF material composite material showed enhanced mechanical properties than the untreated PALF filler in turn; for the TS untreated composite material C3H6O3 [5]. Li C prepared ultra-high molecular weight polyethylene (UHMWPE) fibers, and modified them with 20:25:2 ratios of acetic acid, sulfuric acid and water for different time periods to prepare modified UHMWPE/EP composite materials. The microscopic morphology, chemical composition, contact angle, H sample extraction, tensile properties and bending properties of UHMWPE fiber composite before and after modification were tested and analyzed. The results show that after UHMWPE fiber is treated with the modified solution, the surface roughness of the fiber increases, the contact angle decreases, and the surface chemical composition and type change significantly; the mechanical properties of the composite material are the best when the fiber is treated for 9 minutes, with the same fiber content The specific strength, specific modulus and bending load of the UHMWPE composite material treated for 9 min increased by 16.7%, 82.9% and 55.3%, respectively, compared with the untreated sample [6]. Kos A introduced the SmartSki system, including SmartSki, measurement equipment and several SmartSki applications. Micro sensors have been integrated into various sports equipment. The combination of additional body sensor devices and sensors integrated into sports equipment, coupled with appropriate sensor fusion algorithms, can help develop better sports equipment, speed up the learning process, and improve skills Level and performance. The SmartSki system has been functionally tested and verified by a group of alpine skiing experts through multiple snow tests within a year. The snow test results are used to improve the prototype and extract several important ski parameters for various feedback applications, for example, in the coach feedback system or the skier's real-time biofeedback system. It is believed that SmartSki can bring many benefits to recreational skiers, ski equipment manufacturers, ski schools, coaches and even professional skiers [7]. Varadan V V describes the first direct measurement of material properties and the microwave chiral composite material prepared in our laboratory in the 840 GHz frequency range. We performed reflection and transmission measurements of vertically incident linearly polarized plane waves in a specially designed free-space facility using point-focused antennas. Different concentrations of chiral inclusions in the form of miniature metal springs that are only left-handed, only right-handed, or mixed in equal amounts (racemic) have been studied. The results show that at a given concentration, and of all three samples are comparable, but the values of the left-hand and right-hand samples are equal but opposite, while the isochiral samples are almost zero [8]. Although the above-mentioned theories have explored new materials to a certain extent, they cannot be fully promoted due to the limitations of conditions.

1.4. Innovation

The current research on fiber materials mainly focuses on dyeing performance, and there are few studies on the effect of modified fiber composite materials on the interface performance. Therefore, this article expands the application scope of fiber surface modification. This article is the first time based on the equipment problem in the sports field. Use scientific and technological innovation to apply new materials to sports and promote the development of the sports industry. The research on the properties of modified fiber composites mostly focuses on the interfacial bonding properties of the materials. This article conducts comprehensive tests on the interfacial bonding properties and mechanical properties of the composites, and can discuss the effect of surface modification treatments on the properties of the composites as a whole. .

2. Research Methods of Fiber Surface Modified Composite Materials for Sports Equipment with Dielectric Properties

2.1. Smart Sports

Smart sport is a popular item at the moment. At present, there are two main opinions. One is that smart sports consume brain power and should not be classified as sports. The other view is the opposite, that smart sports are sports. Different opinions differ between the two versions [9]. Since smart sport is a new term and its project settings are under discussion, the academic concept has not yet been determined. At present, smart sports are generally considered to be a major category of sports. Confrontational competition is the core of sports. Smart sports belong to the broad category of sports. Confrontational competition is also its core. However, it is still different from conventional sports. Smart sports require rich imagination and creativity. The acquisition of these abilities must rely on Long-term training and practice. In general, smart sports can exercise the participants' thinking, judgment, and reaction abilities, and also greatly help the participants' mentality [10].

Smart sport is a new type of project, so relevant information is still lacking. The main projects are chess, go and chess. The main research is the meaning and status quo of current smart sports, not how to effectively develop smart sports. As a new type of sports, we should uphold the idea of lifelong sports [11-12]. Both Go and Chess are excellent traditional cultures of the Chinese nation and possess infinite artistic charm. The promotion of such projects can cultivate sentiment, stimulate patriotic enthusiasm, establish correct values, and enrich daily life. Compared with China, smart sports in the West started earlier. Take chess as an example. This type of sport is a popular item in Europe. In the former Soviet Union, a dedicated chess teaching department was set up. Spain and Sweden are in parliament. The proposal to introduce chess into the teaching process was passed. South Korea has a lot of people who can play Go. It can be said that it is the country with the largest proportion of the total population, and it has become a popular university subject project [13]. Figure 1 is a schematic diagram of the smart sports structure:

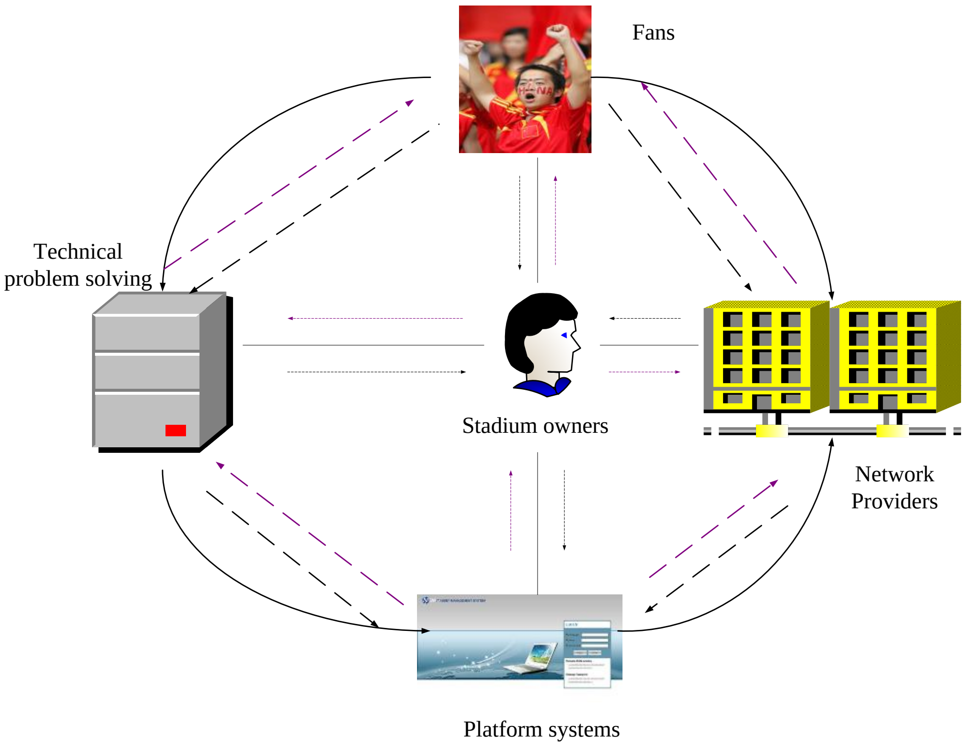

Figure 1. Smart sport structure

2.2. Dielectric Properties

The principle of dielectric properties is that under the action of an external electric field, charges of opposite sex are generated at both ends of the electrode. Due to the attraction of opposite sex, the combination of the two charges will cause Coulomb force and compression phenomenon [14]. If the boundary conditions are ignored, the compression in the parallel direction can be expressed by writing a function expression first:

$$Q_A = -\frac{\alpha\alpha_0}{E}\left(\frac{T}{A}\right)^2 \tag{1}$$

Among them, Q_A represents the amount of change in the plane direction, α represents the relative permittivity of the dielectric, α_0 represents the vacuum permittivity of the dielectric, T represents the magnitude of the external voltage, and A represents the thickness of the sample. The working principle of dielectric materials is shown in Figure 2:

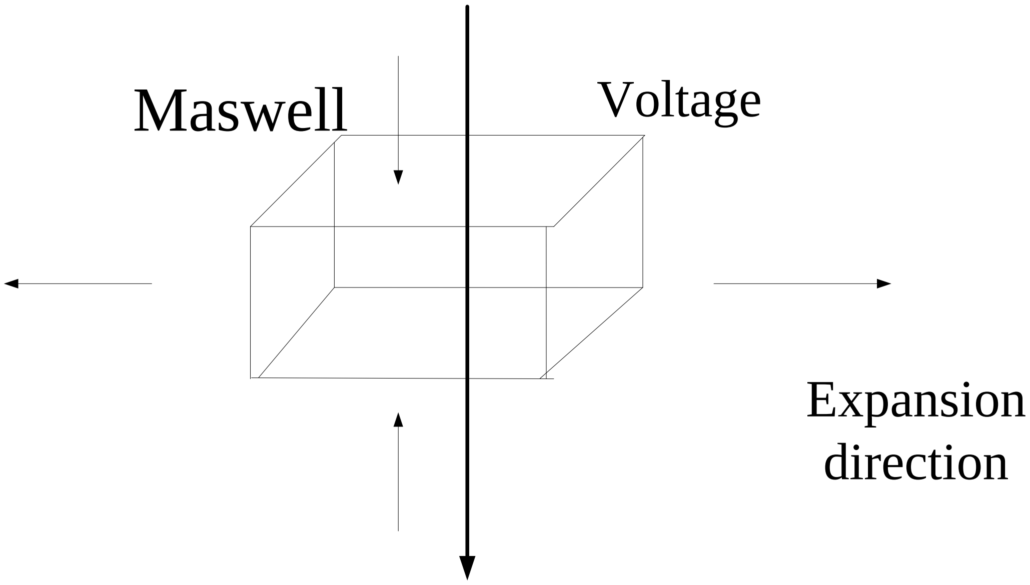

Figure 2 .Working principle of dielectric materials

If the amount of change of the dielectric material on the plane is large, it can be expressed by the following functional expression:

$$(1+Q_o)(1+Q_p)(1+Q_A)=1 \tag{2}$$

Q_O, Q_P, Q_A represent the thickness of the material.

Since it is under the condition that the electro-induced deformation in the plane direction is equivalent, so $Q_O = Q_P = Q_{OP}$ can be obtained at this time:

$$Q_A = (1+Q_{OP})-1 \tag{3}$$

The dielectric constant of a dielectric material can be obtained by capacitance, which is expressed by the following function expression:

$$\alpha = \frac{W}{W_0} + (1+Q_{op})-1 \tag{4}$$

Among them, W represents the material capacitance, W_0 represents the vacuum capacitance value, and α represents the dielectric constant.

The dielectric material will change with the change of the electric field under the action of voltage, so that the dipoles cannot be arranged in order, resulting in the phenomenon of wasting electric energy. In view of this situation, we generally use the following function expression to express:

$$\alpha(\varphi) = \alpha'(\varphi) - i\alpha''(\varphi) \tag{5}$$

In routine use, we are accustomed to express the dielectric loss of a material with a tangent angle, which is generally the ratio of the real part to the imaginary part, which is generally expressed by the following functional expression:

$$\tan\phi = \alpha'' / \alpha' + i\alpha''(\varphi) \tag{6}$$

According to the reasons for wasting electric energy, we divide it into three types, polarization loss, uneven dielectric and conductance loss.

Due to the factors of production process and storage environment, the fiber will suffer some inevitable loss, which weakens the strength of the fiber's monofilament. The specific strength values are as follows:

$$T(\eta) = 1 - \exp\left| -S(\eta / \kappa)^{\alpha} \right| \tag{7}$$

Where $T(\eta)$ represents the possibility of fiber breakage, S represents the length ratio of the fiber, κ represents the scale parameter of the fiber, and α represents the shape parameter. κ, α representative shape parameters. Specifically, it can be expressed by the following function expression:

$$Q = 1 - T(\eta) = \exp\left| -S(\eta / \kappa)^{\alpha} \right| \tag{8}$$

Where Q represents the probability of survival, and other variables are the same as the above formula.

We use the expectation valuation method for the survival probability and perform logarithmic calculations, and we can get:

$$\ln\ln[1/(1 - T(\eta))] = \alpha \ln\eta + \ln S - \ln\kappa \tag{9}$$

At the same time we can calculate the possibility of damage:

$$T(\eta) = m/(M + 1) \tag{10}$$

Where N represents the number of target fibers, and n represents the number of target fibers broken under the action of external force.

By ranking the strengths of all the target fibres and fitting a straight line using least squares, we consider the slope of the line to be the shape parameters, its functional expression can be expressed as follows:

$$\kappa = \exp\left(\frac{\ln S - A}{\alpha}\right) - \ln\kappa \tag{11}$$

Where α represents the slope of the straight line, and κ represents the scale parameter.

The average strength of the fiber is expressed by the following functional expression:

$$\bar{\gamma} = \kappa S^{-1/\alpha} \mu \left(1 + 1/\alpha\right) \quad (12)$$

Where μ represents the Gamma function, and $\bar{\gamma}$ represents the intensity value.

Using X-rays to perform surface treatment on the fiber material, the stacking thickness can be expressed as follows:

$$U_a = \frac{c\delta}{\theta} * \cos\omega \quad (13)$$

Among them, δ represents the wavelength of the ray, ω represents the Bragg angle, θ represents the half-height width of the diffraction peak of the crystal plane, and c represents the shape factor. The value is usually 0.9 for convenience of calculation.

The specific surface area of the sample needs to be measured with a surface analysis instrument, which is mainly calculated according to the following formula:

$$\frac{O}{G(O_0 - O)} = \frac{1}{E_n B} + \frac{B-1}{E_n B} * \left(\frac{O}{O_0}\right) \quad (14)$$

Wherein B represents the surface adsorption capacity of the sample. When the value is larger, the adsorption capacity is stronger. O represents partial pressure, O_0 represents saturated vapor pressure, E represents actual adsorption capacity, and E_n represents monolayer saturated adsorption capacity.

When a layer of nitrogen atoms is adsorbed on the surface of the sample, the specific surface area of the sample can be expressed as:

$$Y = \frac{E_n * M * v}{22400 * D} \quad (15)$$

Where E_n represents the surface adsorption capacity of the sample, M represents a constant, v represents the cross-sectional area of the molecule, and D represents the weight of the sample. Substituting constants with common values can get:

$$Y = \frac{4.36 * E_n}{D} \quad (16)$$

The calculation expression of fiber length can usually be expressed as:

$$\pi f_h k \varphi = \delta \pi f_h^2 / 4 \quad (17)$$

$$k = m \delta f_h / (4\pi) \quad (18)$$

Where f_h represents the diameter of the fiber, k represents the length value, δ represents the shear stress, and φ represents the ultimate tensile stress.

2.3. Sports Equipment

With the development of the economy and the change of sports concepts, the demand for sports is increasing day by day, and the demand for sports equipment is also increasing sharply. Sports equipment is usually combined with "comprehensive fitness". The whole nation represents the people of the whole country. Regardless of age and gender, fitness refers to strengthening strength and improving coordination [15]. Fitness and sports equipment are closely related. When the early western sports were introduced to China, it greatly enriched people's spare time. Physical education courses were also launched in schools, and they changed from unit to diversification. Sports equipment must be used to exercise, because these equipment are invented and developed based on ergonomics and human movement, so that they can be put into use and can better cooperate and serve the health of residents [16]. Figure 3 shows the structure of smart sports equipment:

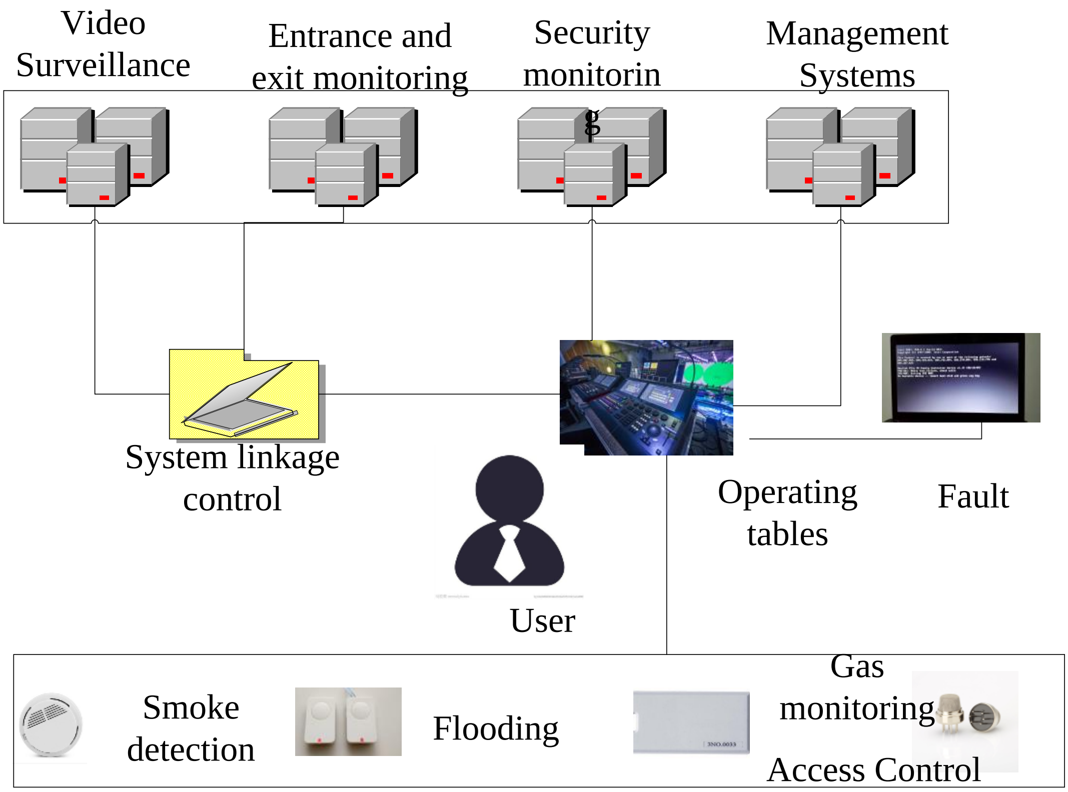

Figure 3. Structure of the smart sports equipment

The industrialization of China's sports industry can be traced back to the early 1980s. After so many years of economic take-off, China’s French sports industry has also grown, and now it has been able to independently produce some specific sports equipment, coupled with the in-depth dissemination of health concepts in recent years, and the holding of international and local sports events, which are greatly encouraged. Residents’ enthusiasm for sports has gradually begun to realize that strengthening physical exercise can not only strengthen the body, but also promote social and economic development and promote communication between people [17]. At present, there are many kinds of sports, which has also led to the diversification of sports equipment. Here we briefly introduce: National defense military sports equipment includes guns, radio communications, etc.; competition equipment includes table tennis, volleyball, badminton, equestrian, etc.; folk Sports equipment includes knives, axes, swords, and spears. Common fitness equipment includes treadmills, dumbbells, and grippers. According to the survey findings, for different service groups in the sports equipment service industry of the layout type, everyone can freely choose sports equipment according to their own needs. The elderly tend to choose activity equipment related to physical rehabilitation training. The sports equipment that boys choose mainly focus on dumbbells, pressurers and basketballs, while the fitness equipment commonly used by girls are mainly hula hoops, yoga mats and treadmills. The equipment is mainly skateboard, roller skates and skipping rope [18-19]. Figure 4 shows common sports equipment:

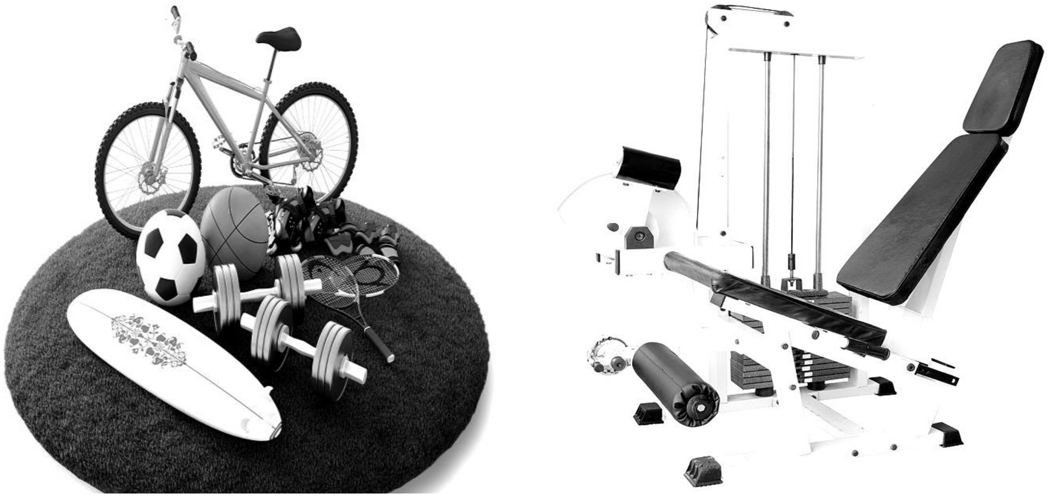

Figure 4. Common sports equipment

3. Research Experiment on Fiber Surface Modified Composite Materials for Sports Equipment with Dielectric Properties

3.1. Fiber Properties

There are a large number of dense cyclic groups inside the fiber, so the stability of the fiber is better, but because of the orderly arrangement of the molecules, the surface of the fiber is smoother, the polarity is smaller, and the adhesion is poor. Table 1 shows the common fiber properties:

Table 1. Comparison of common fiber properties

Type	Strength (GPa)	Modulus (GPa)	Elongation (%)
P84 fibre	0.50	4.7	33
PBO	5.79	175	3.3
Aramid fibre	0.58	10	21
Biphenyl fibres	3.3	181	1.93
T300	2.75	230	*

According to the data in Table 1, fiber materials generally have heat resistance, and their decomposition temperature basically reaches 500 degrees Celsius, which is closely related to the large number of aromatic rings in their molecular chains [20]. At the same time, the dielectric properties of the fiber material are very good. The dielectric constant of the fiber material is basically stable at about 3.5. If other substances are added to the molecular chain, the dielectric constant can be reduced to about 2.6. The dielectric loss and strength are increased to varying degrees, and these properties remain stable over the higher temperature and frequency range. Fiber materials have thermal oxidation stability. If you change the molecular design, you can also get varieties of different structures [21].

3.2. Composite Material Properties

At present, there are many types of composite materials on the market. In the experiment, we take rubber composite materials as an example to explore. As an indispensable material in the high-tech field, rubber has extremely strong reversibility and high elasticity characteristics, and has been widely used in the national economy [22]. With the continuous upgrading of the industrial structure, rubber materials should not be continuously improved to adapt to the development of new industries. Table 2 shows the characteristics of rubber composite materials:

Table 2. Comparison of rubber and rubber composite properties

Amount added (g)	Improving performance	Lifting volume (%)
1.2	Tear strength	78
1.1	Tensile strength	161
1	Tensile strength	73
0.5	Tensile strength	43
0.3%	Thermal conductivity	10

According to the data in Table 2, adding different other materials can change the properties of rubber composites. According to experiments, when 1.2g of material is added, the tear strength of rubber composite material is increased by 78%, when 1.1g of material is added, the tensile strength of rubber composite material is increased by 161%, when 1g of material is added , The tensile strength of rubber composite material increased by 73%, when 0.5g material was added, the tensile strength of rubber composite material increased by 43%, when 0.3%g material was added, the thermal conductivity of rubber composite material increased 10%[23]. According to these data, it can be known that the addition of mass has a great influence on the tensile strength of the rubber composite material. When the mass of the added material is greater, the tensile strength of the rubber composite material increases.

Table 3. Properties of butylbenzene and rubber composites

Amount added (g)	Improving performance	Lifting volume (%)
15%	Tensile modulus	780
15%	Tensile strength	420
15%	Tear strength	730
1	Tensile strength	39
8	Tensile strength	1000

According to the data in Table 3, adding different quality styrene butadiene materials can change the characteristics of rubber composite materials. According to the experiment, when 15%g of styrene butadiene material is added, the tensile modulus of the rubber composite is increased by 780%, and when 15%g of styrene butadiene material is added, the tensile strength of the rubber composite is increased by 420%. When 15%g of styrene butadiene material is added, the tear strength of rubber composite material is increased by 730%. When 1g of styrene butadiene material is added, the tensile strength of rubber composite material is increased by 39%. In the case of benzene material, the tensile strength of the rubber composite material is increased by 1000% [24].

3.3. Surface Structure of Fiber Material

The skin-core structure of the fiber material has a strong surface orientation. After its surface treatment, the dense crystallites on the surface are oxidized into fine crystals, which will cause too much disordered structure in the fiber [25].

Table 4. Comparison of the parameters of the different treated fibre materials

Group	Time (min)	Oxidation temperature (℃)	Parameters (g)
1	20	270	2.51
2	20	320	2.46
3	20	370	2.43
4	40	270	2.41
5	40	320	2.49
6	40	370	2.18

According to the data in Table 4, it can be seen that the parameters of the fibrous material in different ways have changed to different degrees. When the treatment time is 20 minutes and the oxidation temperature is 270 degrees Celsius, the parameter is 2.51; when the treatment time is 20 minutes, the oxidation temperature is When the temperature is 320 degrees Celsius, the parameter is 2.46; when the processing time is 20 minutes and the oxidation temperature is 370 degrees Celsius, the parameter is 2.43; when the processing time is 40 minutes and the oxidation temperature is 270 degrees Celsius, the parameter is 2.41; when the processing time is 40 minutes When the oxidation temperature is 320 degrees Celsius, the parameter is 2.49; when the treatment time is 40 minutes and the oxidation temperature is 370 degrees Celsius, the parameter is 2.18. According to its data changes, it can be concluded that the parameters decrease with the increase of oxidation temperature and time [26]. Figure 5 is a schematic diagram of an oxidation time of 20 minutes:

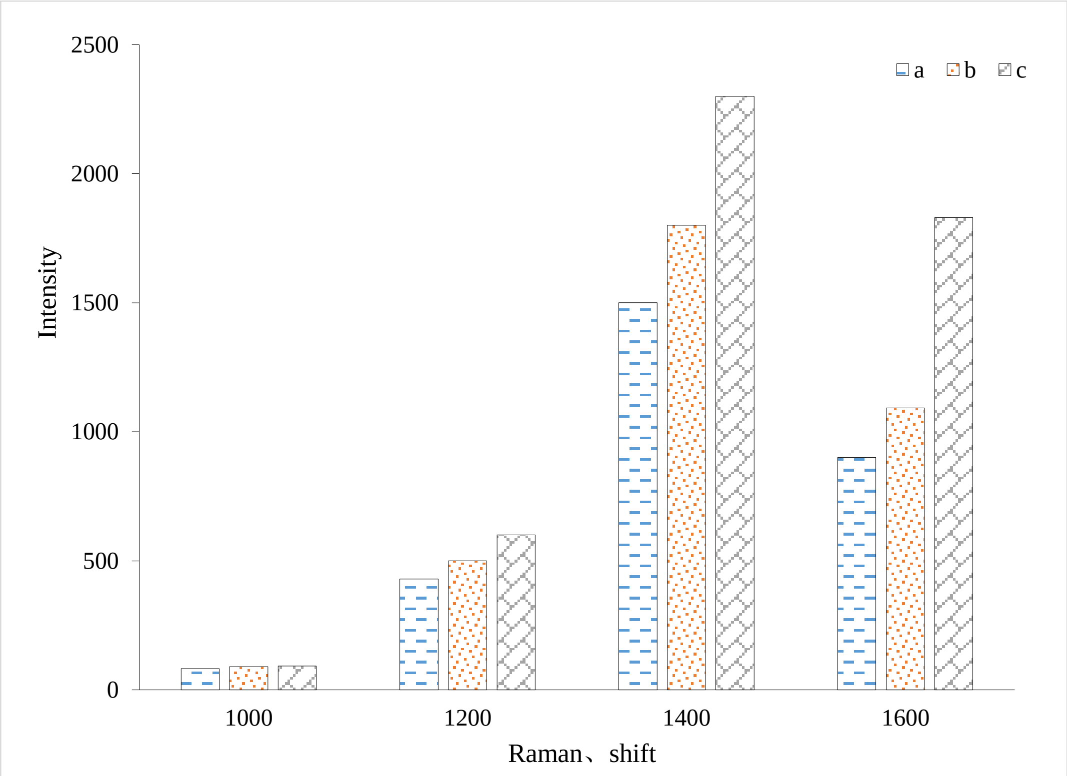

Figure 5. Spectrogram of fibre material

4. Research and Analysis of Fiber Surface Modified Composite Materials for Sports Equipment with Dielectric Properties

4.1. Functional Analysis of Fiber Material Surface

Infrared spectroscopy is needed for functional exploration of fiber materials. In the experiment, the oxidation temperature and oxidation time have been investigated for the functional number of fiber materials [27].

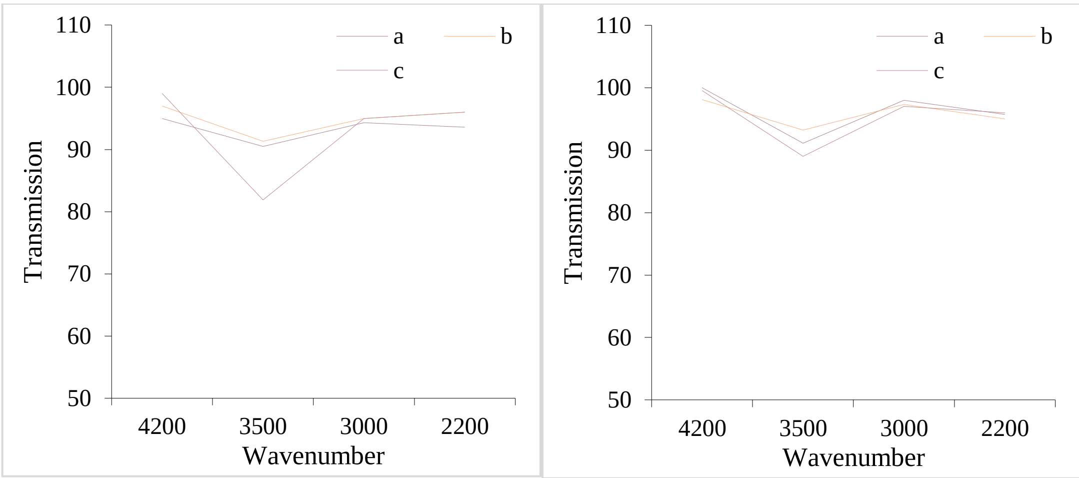

Figure 6. Oxidation time spectra of fibrous materials

According to the data in Figure 6, as the oxidation temperature changes, the change in the surface function of the fiber material can be described as the reduction of carbon-hydrogen bonds; the hydroxyl group first increases and then decreases; a small amount of aldehyde groups appear in the oxidation at temperatures below 500 ℃, and the number of carboxyl groups begins to sharpen At 550℃, the reaction does not produce aldehyde groups, but it is found that there are more carboxyl groups; ether bonds are produced at all temperatures, and the number of ether bonds first decreases and then increases with temperature. This shows that as the temperature increases, the groups that are easily oxidized are different, and the products are also different [28]. The lower oxidation temperature is prone to oxidation reaction of carbon-hydrogen bonds, part of the hydroxyl groups are incompletely oxidized to produce aldehydes, and a small amount of ether bonds are broken at the same time. When the reaction temperature continues to rise, while the carbon-hydrogen bond is broken, the hydroxyl group is oxidized to carboxylic acid, and the reaction occurs at a rate greater than the rate at which the carbon-hydrogen bond is oxidized.

4.2. Thermal Weight Loss of Composite Materials

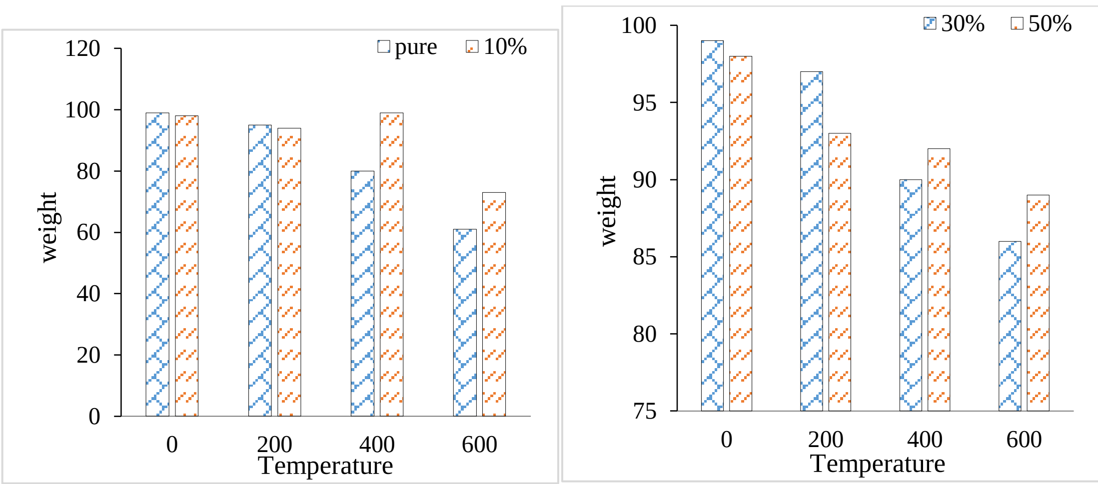

Figure 7. Thermal weight loss of composite materials

According to the data in Figure 7, there will be a decrease when the temperature is around 300 degrees Celsius, but if the proportion of composite materials is increased, the rate of decrease will be reduced. This is because the thermal conductivity of the material is higher than that of rubber. When the material is heated, the material particles can quickly and effectively conduct the heat away, and will not accumulate inside the material. This indicates that the addition of composite materials improves the thermal stability of composite materials, thereby increasing the temperature of use of composite materials. When adding a volume fraction of 50% rubber, the thermal decomposition temperature of a large amount is 400 ℃, and the thermal decomposition temperature increases by 35% [29].

4.3. Dielectric Constant of Composite Materials

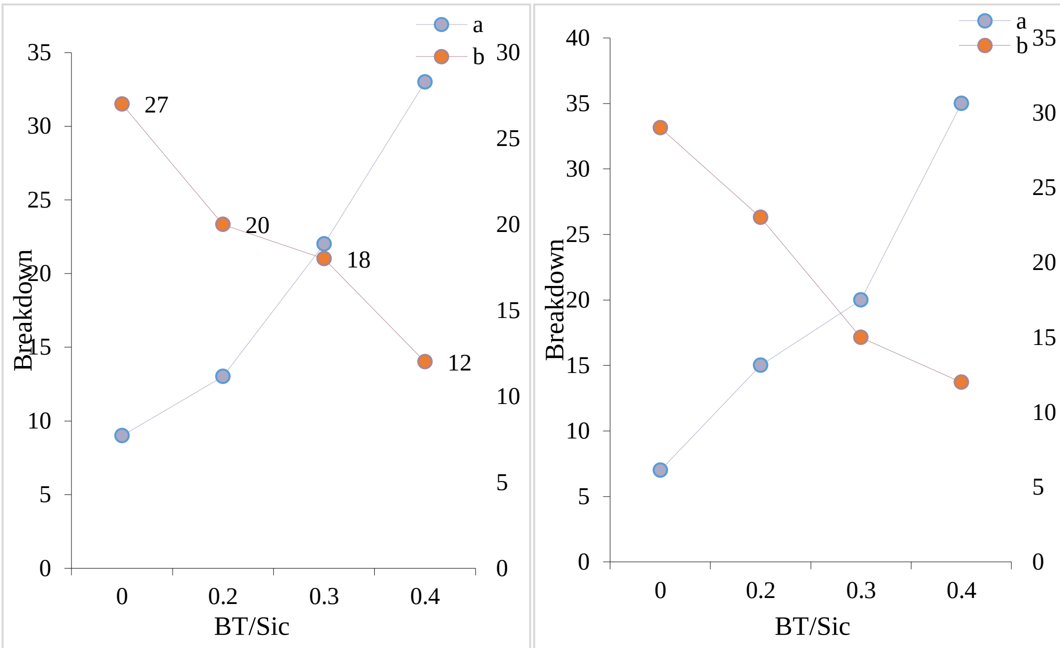

Figure 8. Dielectric constant of composite materials

According to the data in Figure 8, as the dielectric strength of the rubber composite material gradually increases, when the ratio of the composite material is less than 20%, the dielectric strength changes very slowly. When the dielectric strength gradually decreases, when the volume is 40%, the dielectric strength is only 12. Overall the volume of the composite and the dielectric permittivity show an inverse relationship, with the composite getting weaker as the ratio gets higher [30].

5. Conclusion

The theme of this article is to explore the relationship between sports equipment with dielectric properties and fiber surface modified composite materials. Through the analysis of fiber materials, find out qualified composite materials, and elaborate on the applications of various fibers composite materials. In this paper, the following work is mainly completed: (1) It shows that the treatment will not change the functional groups on the surface of the fiber material; the plasma treatment will increase the surface active groups of the fiber and increase the hydrophilicity. (2) proposes the use of alkali treatment and plasma treatment for surface modification of fibres, and the preparation of composite materials by vacuum infusion moulding process using the fibres before and after treatment as the reinforcement as the matrix. (3) At present, China does not have a unified smart sports data, and all uses are compiled by various industries based on the actual situation of smart sports. (4) It was discovered that as graphene rubber composite materials and technology mature day by day, they can be widely applied to all aspects of sports equipment. There are still many shortcomings in the work of this paper: (1) the composite material cannot meet the demanding requirements of thermal protection materials for the time being, and its mold design can be further optimized and improved. (2) The flexural strength and elastic modulus of composite materials have not yet reached the training standards, and further investigation is needed in this regard. (3) The research in this article is only operable under certain conditions. It is also necessary to build a more scientific and reasonable research system or platform to enrich the production methods of sports equipment.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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