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Application of Bim-Based Reverse Four-Dimensional Technology in College Building Project Management

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Abstract: 4D technology based on building information model (BIM) is an important tool to optimize the preparation process of building materials. Based on the principle of 4D technology and combined with the characteristics of building material optimization and practical requirements of the extension project of the university, an innovative application method of reverse 4D technology is put forward. Copolymerization low thermal expansion, the preparation of polyimide film, for example, by building a relatively symmetric rigid molecular structure of 4 d model of the monomer, able to form the core of the molecular structure of six fluoride acrylic (4, 4 `), 2 (6) to the fda phthalic anhydride, diamino ` (2, 2), double three fluorine biphenyl (TFMB), and other key molecules and key performance characterization analysis of high precision. Empirical analysis results show that using reverse 4 d based on BIM technology, can be in reconstruction project of colleges and universities need to the copolymerization of thermal expansion of the polyimide film thermal stability and heat resistance of high precision reduction simulation, and the dielectric constant of thin film, light transmittance of copolymer film, film tensile strength and modulus of elasticity and quantitatively measure the positive changes in relationships between thermal expansion coefficient, which realizes the visualization of construction materials and information of the whole sequence optimization.

1. Introduction

Building Information Modeling (BIM) has been gradually expanded from traditional 3D application to nD application since it was introduced into China’s Building materials industry in 2003. 4D technology is an information technology that adds a time dimension on the basis of 3d-bim and visualizes and simulates various properties and characteristics of building materials according to the progress of time. With the progress of microelectronics technology and material science, new apparent building decoration technologies keep emerging, among which flexible building decoration is one of the most concerned fields. Flexible building decoration is a kind of flexible flexible building with memory characteristics. In the mezzanine, the substrate plays the role of supporting and protecting the internal components, which has an important impact on the performance and service life of this building decoration material. ITO glass is the main substrate material for exterior decoration of traditional buildings, but its flexibility is poor. It is the development trend of flexible buildings to replace inorganic materials with transparent polymer materials with high transparency and thin flexibility. To be used as flexible building substrate material, it needs to meet the requirements of high optical transparency, good heat resistance, high chemical stability, excellent water and oxygen resistance, and certain mechanical characteristics. General polymer materials have poor heat resistance and are difficult to meet the requirements of flexible construction. Polyimide (PI) has the advantages of high heat resistance, oxidation resistance, chemical corrosion resistance and mechanical strength, etc. However, there are conjugated elements in polyimide molecules, which are easy to generate charge transfer complexes. As a result, most ordinary polyimide films are browned and yellow, and have low light transmittance in the range of visible light, which is difficult to be applied in photoelectric equipment with strict transparency requirements. Fluorine atom is more electronegative, which can block the conjugation of electron cloud and reduce the formation of CTC. Therefore, introducing fluorine-containing groups into polyimide molecules has become the main method of making transparent polyimide films at present.

At present, there are some problems with fluoropolyimide: 1) polyimide molecular chains are loosely arranged due to the greater steric resistance of trifluoromethyl, which leads to the higher linear thermal expansion coefficient. (2) Since the reaction of diamine and dihydride to form polyamides is in the form of inter-molecular charge transfer, the introduction of fluorine atom will inhibit the charge transfer, which weakens the reaction activity of monomer, leads to a long acylation reaction time and a reduction in product molecular weight, thus affecting the comprehensive properties of materials. (3) The high cost of fluorine-containing monomer makes the finished product expensive. The main way to solve this problem is copolymerization. Copolymerization is to change the molecular regularity of the polymer by introducing a third monomer, so as to affect the intermolecular interaction force, and then change the microstructure of the film, so as to influence its macroscopic energy. Anthony Browne (2019) it was found that the polyimide film obtained by the polymerization of symmetric para-aromatic diamine and biphenyl anhydride has the lowest thermal expansion coefficient, and the CTE is lower if the benzene ring has methyl groups. With highly symmetrical molecular structure and strong rigidity, dpa is more likely to form regular arrangement in plane orientation, thus obtaining lower CTE and higher reactivity, which can improve reaction rate of polymerization system and comprehensive performance of products. And the market price of PMDA is much lower than that of fluorine-containing monomer. Replacing fluorine-containing monomer with part of cheap rigid monomer without affecting the comprehensive performance of finished products can effectively reduce the production cost. At present, there are few researches on the preparation of transparent polyimide films with low thermal expansion coefficient by using PMDA monomer and fluorine-containing monomer. In this paper, based on 4 d based on BIM technology, build the fluoride monomer 6 fda and TFMB copolymerization preparation transparent molecular structure of polyimide film visual images, and to explore the influence of copolymerization on the properties of fluorinated polyimide film and this kind of material in the concrete application of the reconstruction project in colleges and universities, for high performance of home-made transparent polyimide film [1].

2. Reverse 4d Technology and the Principles of Bim

Reverse technology is a transformational technology formed by reverse thinking and innovation of traditional technology, such as reverse engineering technology mainly based on reverse r&d and reverse design in high-tech and assembly manufacturing industry and reverse BIM technology and reverse practice applied in building decoration materials. Based on the basic principle of Reverse technology, change the traditional focus of 4 d technology -- the “building” and the way of modeling, simulation model growth process (from bottom to top, from scratch), can be focused on the "restructuring" - fading process simulation model (from top to bottom, from there to none), Reverse 4 d technology (Reverse 4 dtechnology, R - 4 d) arises at the historic moment.

(1) Reverse 3d modeling. Old buildings often lack original design information due to their age, so reverse modeling can restore their data model. In reverse modeling, 3D Laser Scanning (3D Scanning) was performed on the old building entity and surrounding environment to obtain the 3D geometric model, and then repeated optimization and addition of non-geometric information according to the actual situation to obtain the bim-based 3D model. Based on the 3d-bim obtained by reverse modeling such as 3D scanning, the model precision is between LOD200 and LOD300, which can assist in the formulation of demolition construction process [2].

(2) Reverse engineering schedule. For some special and complex building, in the process of demolition, to consider the regularity of building decoration materials development, and to consider the parts of the old building decoration materials for recycling, so often need to research the old building of the original construction technology and procedure, and combining with reverse modeling of 3 d - BIM set schedule. Traditional gantt chart based progress plans are often unable to achieve complex and interwoven construction organization. With the help of reverse 4D technology, the compilation of demolition project progress plans and three-dimensional virtual building information model can help optimize the management of demolition work [3].

(3) Inverse growth of 3D model. In 4D software, the demolition progress plan is linked with the 3d-bim of the building to simulate the extinction process of the 3D model, and then repeated optimization is carried out to obtain the reverse 4D model of the building to be demolished, so as to realize the visualization of the demolition process of the building to be demolished and apply it to the analysis and management of demolition.

3. Experimental Materials and Methods

3.1 The Main Raw Material

4,4'-(hexafluoroisopropylene) diphthalic anhydride (6FDA), 4,4'-diamino-2,2'difluoromethyl biphenyl (TFMB), tianjin zhongtai chemical technology co., LTD. 1, 2, 4, 5-phthalic anhydride (PMDA), produced by Shanghai saya fine chemical co., LTD. The above drugs should be dried before use. N, N- dimethyl acetamide (DMAc, analytical pure), sinopolymer chemical technology co., LTD.

3.2 Preparation of Polyimide Films

The synthesis process of pi-1 is taken as an example to illustrate the preparation method of the thin film. Calculate and weigh the medicine in advance. To clean, dry in 100 ml of three bottles of adding suitable amount of solvent and diamine, under nitrogen protection, stir to dissolve diamine, then add the 6 fda, using oil bath is heated to 65 ℃ and continue stirring, after 3h points three times to join the PMDA, every 20 min, continue to 3 h after stop heating and stirring reaction, the polymer solution vacuum suction filter to remove air bubbles and impurities.

The solution is evenly coated on the dry and clean polyester film, immersed in the mixed solution of acetic anhydride and pyridine (V acetic anhydride: V pyridine = 2:1) for 30min, then take out the film and put it into the oven and heat it to 150℃ for drying. After cooling, dip the polyester film in deionized water and peel off the polyimide film.

3.3 Test Results and Characterization Based on Bim4d Model

Infrared spectrum (IR): it was measured by TENSOR27 Fourier transform infrared spectrometer, and the scanning range was 600~4000 cm^{-1}. Uv-vis spectrum (uv-vis): UV2550 uv-vis spectrophotometer was used to determine the scanning range of 200 ~ 800nm; Thermogravimetric analysis (TGA) was conducted by TG209F3 thermogravimetric analyzer. The test atmosphere was N2 atmosphere, the heating rate was 20℃/min, and the test temperature range was 400 ~ 800℃. Dielectric properties: adopt alpha-a wide-band dielectric spectrum analyzer, electrode type: copper, electrode diameter: 20nm, sample thickness: 25 microns; the glass transition temperature and thermal expansion coefficient were measured by Q400EM thermo-mechanical analyzer. The atmosphere was air, the heating rate was 5℃/min, and the temperature range was 25-300 ℃. The characteristic viscosity was measured by uhlmann viscometer (capillary diameter 0.5mm) at 25℃, with dimethyl acetamide as solvent and solution mass concentration 0.5 g/dL.

4. Conclusions

In this paper, BIM-4D technology is used to study the physical and chemical properties of copolymer low-thermal expansion polyimide film, such as thermal properties, insulating properties and light transmittance, and to simulate the application of this new building material in the reconstruction and expansion project of universities. The research conclusions are as follows:

(1) The thermal properties of the film are directly proportional to the PMDA content. When the PMDA content reaches 40%, the thermal decomposition temperature and glass transition temperature of the film increase by 38 respectively. 32 ℃, and 32. 92℃, which enables the film to withstand the high temperatures of the building decoration process.

(2) The permittivity of the film increases with the increase of PMDA content, but when PMDA content is less than 20%, the permittivity of the film is still less than 2. 5, can effectively reduce the delay and power loss in the process of electronic signal transmission.

(3) The light transmittance of copolymerized film decreases with the increase of PMDA content, but when the PMDA content is 30%, the light transmittance of the film at 450nm is close to 90%, maintaining good light transmittance in the range of visible light, which can meet the needs of flexible building decoration.

(4) Compared with the film without PMDA, the characteristic viscosity of the precursor solution with 30% PMDA was increased by 34%, the tensile strength and elastic modulus were increased by 44% and 31%, and the breaking elongation was reduced by 19%. However, when PMDA content exceeds 30%, tensile strength and elastic modulus of the film decrease.

(5) When the PMDA content is 40%, the thermal expansion coefficient of the film is reduced by 50%, which can maintain good dimensional stability even in the case of large temperature difference.

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