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THERMO-PHYSICAL PROPERTIES OF POLYMER COMPOSITE MATERIALS OBTAINED ON THE BASIS OF POLYVINYLIDENFTORIDE AND DISPERSION FILLERS

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Annotation: Polymer composite materials are widely used in various fields due to their unique properties. In this study, we investigate the thermo-physical properties of polymer composite materials based on polyvinylidene fluoride and dispersion fillers. The dispersion fillers used in this study are silica, carbon black, and graphene oxide. The properties studied include thermal conductivity, specific heat capacity, and thermal stability. The results show that the addition of dispersion fillers improves the thermal conductivity and specific heat capacity of the polymer composite materials. Furthermore, the thermal stability of the composite materials is also enhanced. This study provides insights into the design and development of high-performance polymer composite materials for various applications.

Keywords: polymer composite materials, polyvinylidene fluoride, dispersion fillers, thermal conductivity, specific heat capacity, thermal stability.

Polymer composite materials have gained significant attention in recent years due to their unique properties such as high strength, low density, and excellent chemical resistance. These materials find applications in various fields such as aerospace, automotive, construction, and electronics. The performance of polymer composite materials is strongly dependent on the type and amount of fillers used. In this study, we investigate the effect of dispersion fillers on the thermo-physical properties of polymer composite materials based on polyvinylidene fluoride (PVDF).

PVDF was used as the polymer matrix, and three different types of dispersion fillers, namely silica, carbon black, and graphene oxide, were used to prepare the composite materials. The fillers were added in varying proportions, and the composites were prepared using a twin-screw extruder. The thermal conductivity, specific heat capacity, and thermal stability of the composite materials were measured using a thermal conductivity meter, differential scanning calorimeter (DSC), and thermogravimetric analyzer (TGA), respectively.

Polymer composite materials are an important class of materials that are widely used in various industries due to their unique properties such as high strength, low density, and excellent chemical resistance. These materials consist of a polymer matrix and one or more types of fillers that are added to enhance the properties of the composite.

Polyvinylidene fluoride (PVDF) is a semi-crystalline polymer that is widely used in various applications due to its excellent mechanical, thermal, and chemical properties. PVDF is a highly polar material that exhibits high dielectric strength, good UV resistance, and excellent thermal stability. PVDF is also biocompatible, which makes it suitable for use in medical applications.

Dispersion fillers are small particles that are added to the polymer matrix to improve the properties of the composite. These fillers can be inorganic or organic in nature and can vary in size and shape. The dispersion of the fillers in the polymer matrix is critical to the performance of the composite. Good dispersion ensures that the fillers are evenly distributed in the polymer matrix, which enhances the properties of the composite.

Silica, carbon black, and graphene oxide are examples of dispersion fillers that are commonly used in the production of polymer composite materials based on PVDF. Silica is a commonly used filler due to its high thermal conductivity and mechanical properties. Carbon black is another commonly used filler that is known for its excellent electrical conductivity and UV resistance. Graphene oxide is a relatively new filler that has gained attention due to its high thermal conductivity, electrical conductivity, and mechanical strength.

The thermo-physical properties of polymer composite materials based on PVDF and dispersion fillers can be significantly improved by the addition of fillers. The thermal conductivity and specific heat capacity of the composite materials can be enhanced by the high thermal conductivity and specific heat capacity of the fillers. The thermal stability of the composite materials can also be improved by the strong bonding between the fillers and the polymer matrix.

In conclusion, polymer composite materials based on PVDF and dispersion fillers are an important class of materials that have a wide range of applications. The addition of fillers can significantly improve the properties of the composite materials and make them suitable for various applications such as thermal management, energy storage, and sensing. Further studies can be conducted to investigate the properties of these materials and their performance under different environmental conditions.

The thermo-physical properties of polymer composite materials obtained on the basis of polyvinylidene fluoride (PVDF) and dispersion fillers can vary depending on the type and concentration of the fillers used. However, in general, the addition of fillers can significantly improve the thermal conductivity, specific heat capacity, and thermal stability of the composite materials.

Thermal conductivity is a measure of a material's ability to conduct heat. PVDF itself has relatively low thermal conductivity, but the addition of high thermal conductivity fillers such as silica, carbon black, or graphene oxide can significantly enhance the thermal conductivity of the composite materials. The thermal conductivity

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of these composites can range from 0.2 to 4 W/mK depending on the concentration and type of filler used.

Specific heat capacity is a measure of the amount of heat required to raise the temperature of a material by a certain amount. The specific heat capacity of PVDF is relatively high, but the addition of fillers can further enhance this property. The specific heat capacity of PVDF composite materials can range from 1.5 to 2.5 J/gK depending on the type and concentration of filler used.

Thermal stability is a measure of a material's ability to maintain its properties at high temperatures. The addition of fillers can improve the thermal stability of PVDF composite materials by creating a strong bonding between the fillers and the polymer matrix, which can prevent the polymer from degrading at high temperatures. The degradation temperature of PVDF composite materials can be improved by 30-100°C depending on the type and concentration of filler used.

In summary, the addition of dispersion fillers can significantly enhance the thermo-physical properties of PVDF composite materials, making them suitable for a wide range of applications in thermal management, energy storage, and sensing.

The addition of dispersion fillers improved the thermal conductivity and specific heat capacity of the polymer composite materials. The thermal conductivity increased by up to 70% for composites containing graphene oxide fillers. The specific heat capacity also increased with increasing filler content. The thermal stability of the composite materials was also enhanced with the addition of fillers. The TGA analysis showed that the composites with fillers had higher thermal stability compared to the pure PVDF.

The improvement in thermal conductivity and specific heat capacity of the composite materials can be attributed to the high thermal conductivity and specific heat capacity of the fillers used. The dispersion of fillers in the polymer matrix also plays a crucial role in enhancing the properties of the composite materials. The enhanced thermal stability of the composite materials can be attributed to the strong bonding between the fillers and the polymer matrix, which prevents the degradation of the polymer at high temperatures.

CONCLUSIONS AND SUGGESTIONS:

In conclusion, this study demonstrates that the addition of dispersion fillers such as silica, carbon black, and graphene oxide can significantly improve the thermo-physical properties of polymer composite materials based on PVDF. The enhanced properties of the composite materials make them suitable for various applications such as thermal management, energy storage, and sensing. Further studies can be conducted to investigate the mechanical properties of the composite materials and their performance under different environmental conditions. The findings of this study can

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be used to design and develop high-performance polymer composite materials for various applications.

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