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Effective Dispersion of BNNT through Electron Beam Induced Graft Polymerization

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1. Introduction

Boron nitride nanotubes (BNNTs) exhibit superior dielectric properties, high thermal stability, excellent thermal conductivity, and neutron shielding capability compared to structurally similar carbon nanotubes (CNTs). They are electrically insulating materials with potential applications in various fields such as aerospace and medicine [1,2]. However, a significant challenge in utilizing BNNTs lies in their dispersion, which is crucial for practical applications. In this study, we attempted to functionalize BNNTs through the process of graft polymerization, utilizing electron beam irradiation. Our goal was to maintain the unique properties of BNNTs while enhancing their dispersibility and stability.

2. Experimental methods

2.1 Graft polymerization

Boron nitride nanotubes (BNNTs) were utilized in this study utilizing NanoBornNT-90, a product of NAIEEL technology. An aqueous solution containing BNNTs, acrylic acid (AAc), and Mohr's salt was prepared and subjected to nitrogen purging for 30 minutes before sealing. The sealed solution was subjected to absorbed doses of electron beams ranging from 10 to 50 kGy at a dose rate of 533 Gy/s. The grafted samples underwent approximately 10 cycles of washing to remove homopolymers formed from AAc exposed to Mohr's salt and electron beam irradiation. Subsequently, vacuum drying was conducted at 60°C for 24 hours.

2.2 Measurement

The grafting yield of the grafted samples was confirmed through TGA (Thermogravimetric Analysis). Additionally, the presence of C=O functional groups was observed via FT-IR. The functionalized BNNTs, dispersed in water at a concentration of 0.1 mg/ml, were used to measure the UV-Visible spectrophotometer of the sample.

3. Results and Discussion

As the absorbed dose increased, BNNTs exhibited higher grafting yield; however, a decrease was observed beyond a certain absorbed dose. Additionally, the FT-IR spectrum of the grafted BNNTs showed a small peak at 1718 cm^{-1}, indicating the presence of carboxyl acid groups (C=O functional groups). This confirms the successful grafting of PAAc onto BNNTs.

Table 1 The grafting yield as a function of absorbed dose

Dose	Grafting yield
10 kGy	6.9
20 kGy	8.7
30 kGy	9.3
40 kGy	9.1
50 kGy	13

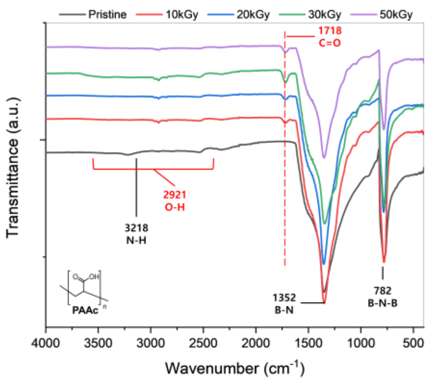

Fig. 1. The FT-IR analysis of grafted BNNTs.

4. Conclusion

We attempted to functionalize Boron Nitride Nanotubes (BNNTs) through the graft polymerization process using electron beam irradiation. The grafting of BNNTs yielded superior results in terms of dispersion compared to pristine BNNTs, without compromising the inherent properties of BNNTs. Furthermore, based on various analyses, we were able to confirm the successful grafting.

REFERENCES
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