IOCM 2025 Conference
The 4th International Online Conference on Materials
03–05 November 2025 | Online
MDPI

Recent Advances in Carbon Nanotube-Reinforced Epoxy Composites: Enhancing Tensile Strength through Nanoscale Reinforcement

Partha Protim Borthakur , Madhuriya Saikia, Elora Baruah, Keshab Biswakarma
Department of Mechanical Engineering, Dibrugarh University, Dibrugarh, 786004, India

INTRODUCTION & AIM

Carbon nanotube (CNT)-reinforced epoxy composites are high-performance materials known for their exceptional mechanical, thermal, and electrical properties. Their high aspect ratio and tensile strength enhance load-bearing capacity, making them ideal for aerospace, automotive, and structural engineering applications.

METHOD

A review of multiple studies examined CNT concentration, dispersion techniques, functionalization (e.g., amino, COOH groups), and hybridization with graphene nanoplatelets (GNPs). Evaluated properties: tensile, flexural, compressive strength, fracture toughness, impact resistance, and elastic modulus.

Summary Table

Property	Improvement (%)	CNT Content/Type
Transverse Tensile Strength	32.7%	0.5% CNT
Tensile Modulus	9%	0.5% CNT
Flexural Strength	44%	1.5 wt% COOH-MWCNT
Flexural Modulus	16%	1.5 wt% COOH-MWCNT
Compressive Strength	28.7%	0.3% CNT
Fracture Toughness	95%	Aminated CNT
Impact Strength	69%	CNT/GNP Hybrid
Hardness	Max @ 0.8 vol%	CNT
Thermal Stability	130%	CNT/GNP

RESULTS & DISCUSSION

- 0.5 wt% CNT → +32.7% tensile strength, +9% modulus
- 2.0 vol% CNT → +26.7% tensile, +21.5% modulus
- Amino functionalization → +42% tensile, +95% fracture toughness
- 1.5 wt% COOH-MWCNT → +44% flexural strength, +16% modulus
- CNT/GNP hybrid → +69% impact, +130% thermal stability
- Optimal CNT loading: 0.15–0.8 vol%

CONCLUSION

CNT addition enhances strength, stiffness, and toughness via better stress transfer and crack deflection. Functionalization and hybridization further boost interfacial bonding. Future work: scalable processing and hybrid architectures for industrial use. Optimizing CNT concentration is critical. Studies show optimal tensile and flexural property gains at concentrations like 0.15 wt%

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