The Structural Effect of Varied Molecular Weight Jeffamine on the Properties of Epoxy-Amine Networks

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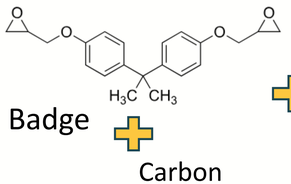
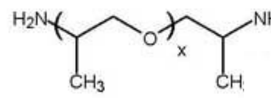
Purpose

The purpose of this research is to determine how varying hardeners affects the structural properties of epoxy–amine networks reinforced with carbon nanotubes. Analyzing how the changes impact material performance, this research strives to create optimized nanocomposite materials with properties suited for specific applications in semiconductor manufacturing and advanced technology systems.





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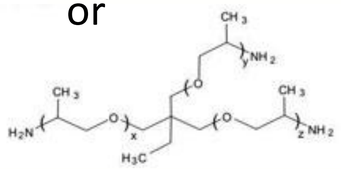
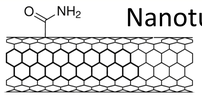
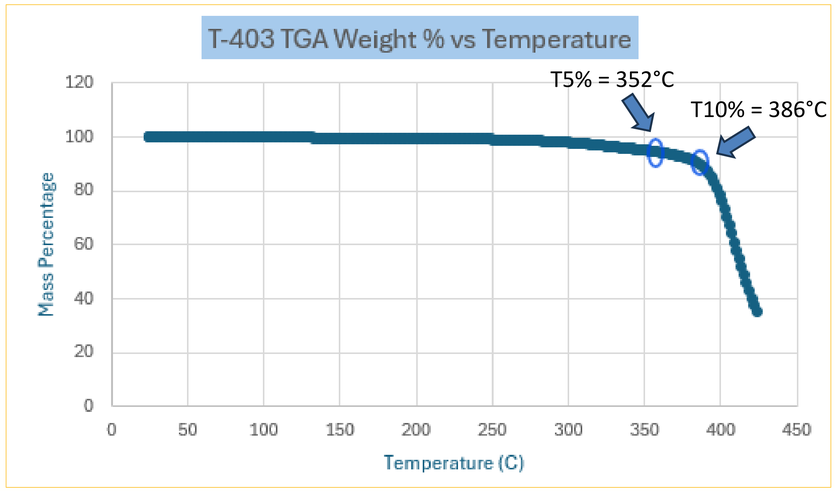




Abstract

Modern society depends on materials with properties suited for a wide range of applications, from engines and medical devices to everyday products. Carbon nanotubes are highly versatile materials with strong mechanical, thermal, and electrical properties, making them useful in many fields. This research investigates how different molecular weights of hardeners affect the mechanical properties of epoxy-amine networks reinforced with carbon nanotubes. It is predicted that higher molecular weight hardeners will produce more flexible materials, while lower molecular weights will result in more rigid materials with higher thermal resistance and mechanical strength. This research will provide insight into how material properties can be adjusted for different applications, particularly in semiconductor manufacturing, where improved thermal conductivity and durability are important.



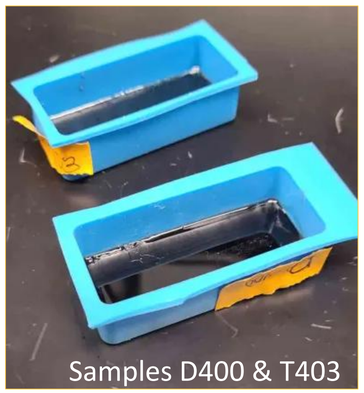
Results

Performing Thermogravimetric Analysis (TGA) revealed that the T403 sample degraded 5% of its original mass at 352°C, whereas D400 degraded 5% at 379°C. D400 has a lower molecular weight and is a more thermally and structurally stable molecule, making it a better fit for semiconductor applications, where withstanding heat is an essential characteristic of the materials involved.

Thermogravimetric Analysis Instrument

Property	D400	T403
Type	Difunctional amine	Trifunctional amine
Functional Groups	2 amine groups	3 amine groups
Structure	Linear / chain-like	Branched / 3D network
Crosslinking Style	Uniform, linear networks	Branched, complex networks
Rigidity	Generally more rigid	More flexible (network-dependent)

Table comparing D400 and T403. Increased functionalization of amine networks results in more branching and lowering molecular stability, resulting in reduced structural and thermal stability.


Samples D400 & T403

Future Work

My future work with this project involves further testing the impact of varying both molecular weight and functionalization of polymer networks to determine the impact on structure and resulting properties. Further tests include Differential Scanning Calorimetry (DSC) test to determine heat flow through samples and regions of stability, and Dynamic Mechanical Analysis (DMA) to understand the material's viscoelastic properties.

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