Mechanical Properties of dynamic h-BN/epoxy composite

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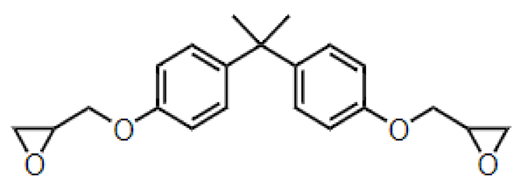
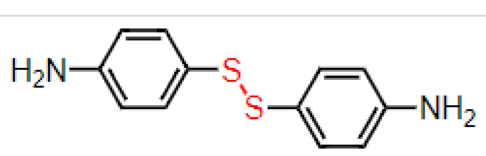
Introduction

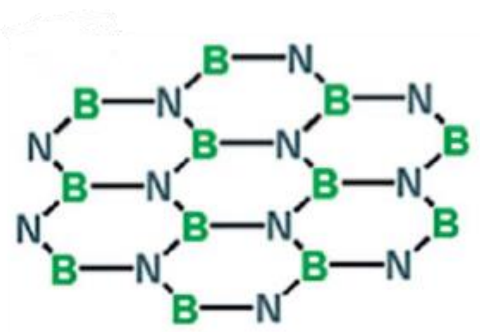


Epoxy

hBN



Amine



Epoxy has many unique properties that include durability, heat resistance, and lightweight. We mix epoxy resin with a disulfide-containing amine, which will co-react together to produce a strong structural material. We also use h-BN because it is a rigid reinforcement and thermally conductive. We examine materials with cylinder and rectangular shapes using cylindrical compression and dynamic mechanical analysis. The outcome will demonstrate how the material is able to sustain high stresses and heat, making it a valuable material for engineers who will utilize it to build powerful structural machines etc.

Methodology

Solution preparation:
Sonicated 1wt% h-BN solution with ethanol for 30 min to disperse solution.

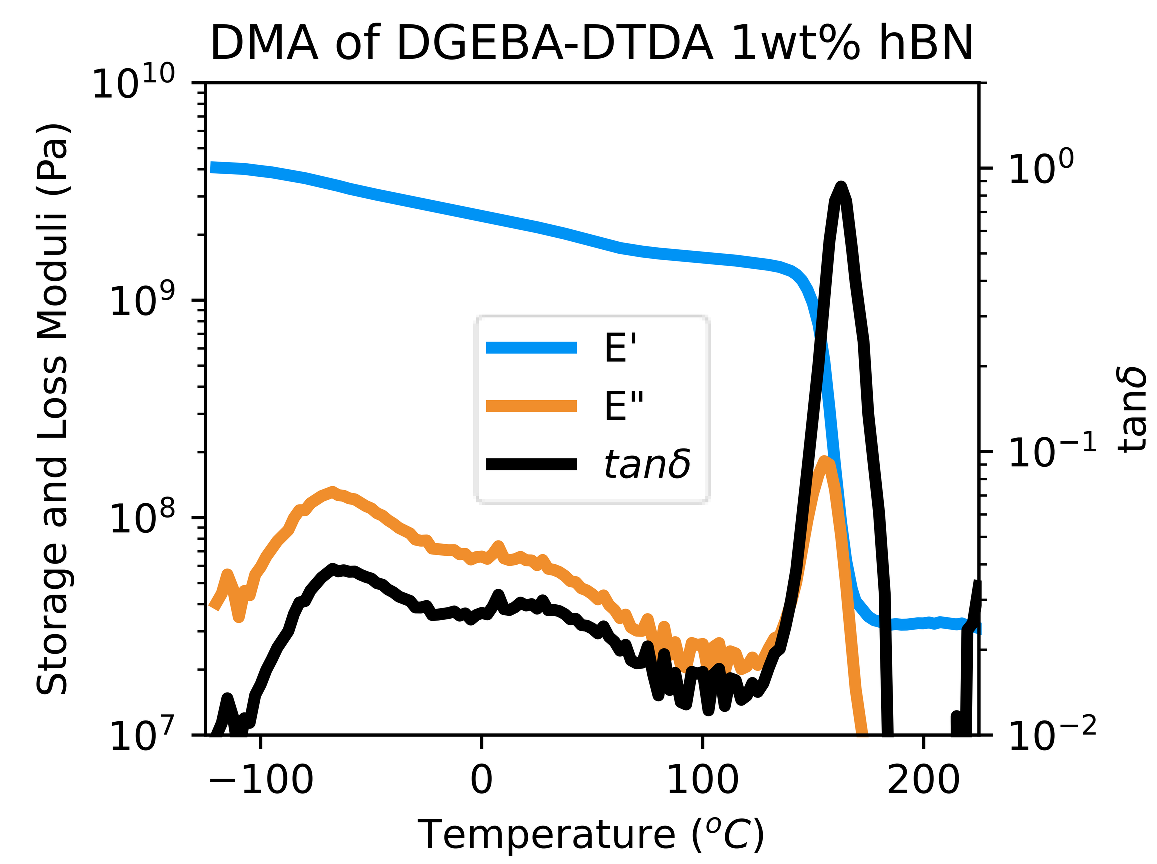
Composite preparation:
Lowered the viscosity of epoxy by heating on a hotplate at 90°C before combining with the amine and h-BN solution. Degassed the mixture at 90°C in a vacuum oven before transferring into silicone mold and repeated degas and purged with nitrogen. Precured at 110°C for 30 min before curing the composite at 160°C for 480 min.

DMA testing(TA Instruments RSA III):
Polished the dimension of the rectangle by 3mm x 1mm x 30mm before applying on DMA.
Measured storage and loss moduli and tanδ at -120 to 225°C at 2.5°C increment and 60s soak with a 1 Hz 0.1% mean tensile strain.

Cylinder-compression test(MTS Criterion 100kN load cell):
Applied the targeted cylinder dimensions by 25.4mm x 127mm at a room temperature with a Crosshead speed 1.33mm/min
ASTM D695

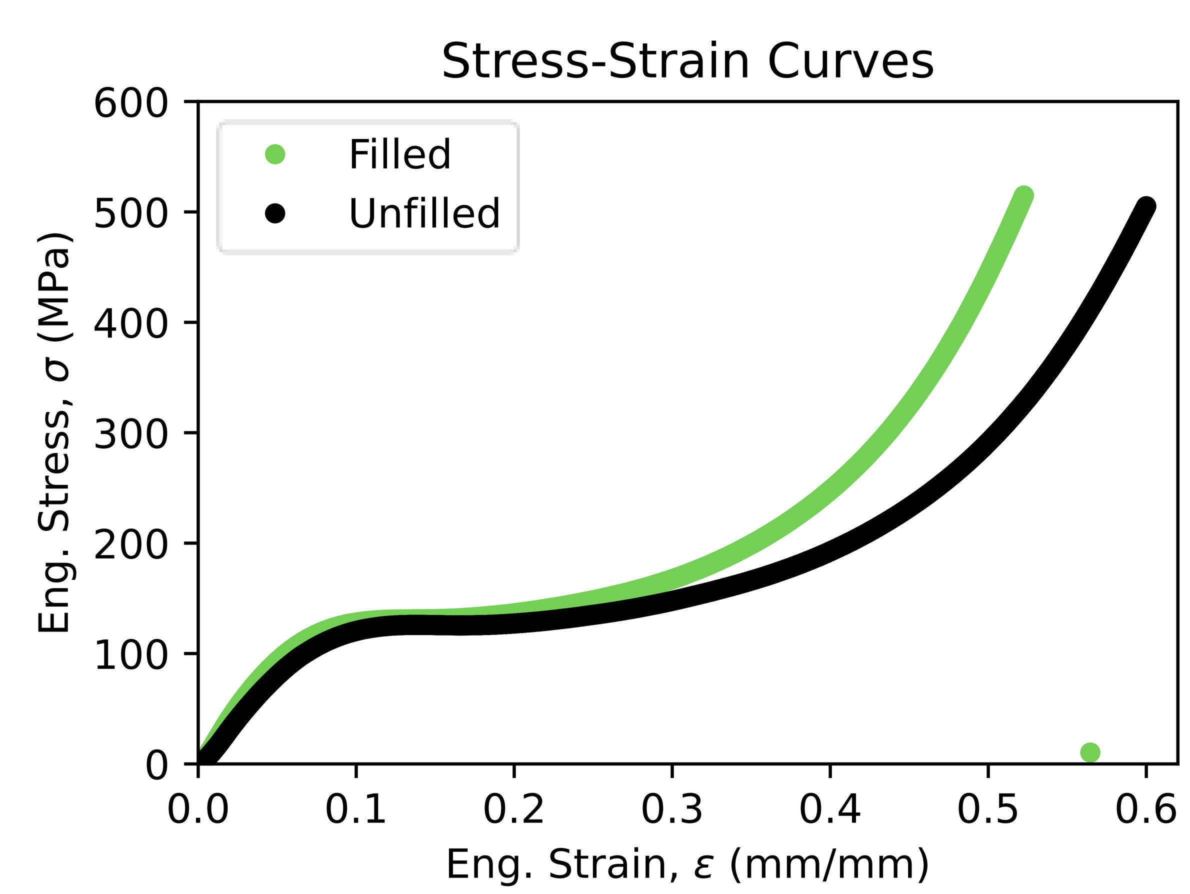
Results

Dynamic Mechanical Analysis



	T_g (°C)
Unfilled	155.87 ± 3.26
Filled	164.61 ± 3.03

Uniaxial Compression

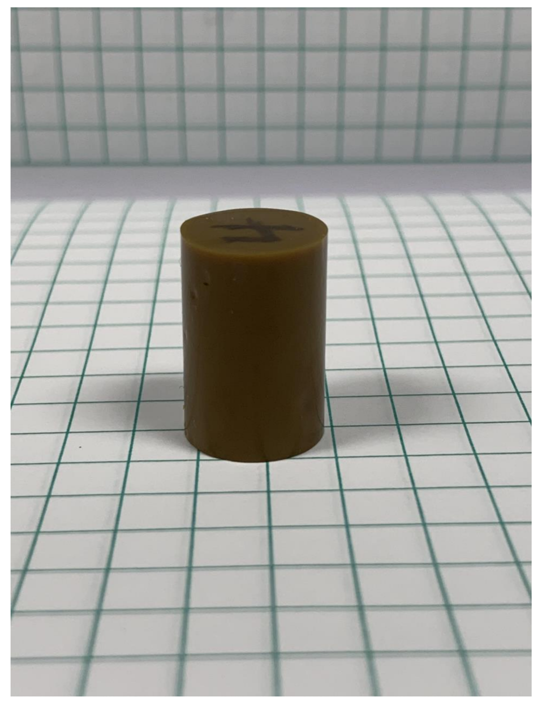


	E (GPa)	*σ_y (MPa)*
Unfilled	*2.21 ± 0.10*	*128.38 ± 0.37*
Filled	*2.27 ± 0.08*	*130.22 ± 0.65*

Conclusion

- DMA:
The glass transition temperature of the composite increased with the addition of the h-BN filler.
- Uniaxial Compression:
Both unfilled and filled epoxy's elastic modulus are relatively the same.

The yield strength of the filled composite is higher than the neat epoxy.



References

1) Yu, C., et al. *RSC Adv.* (**2018**), 8, 21948.
2) Ruiz de Luzuriaga, A., et al. *Mater. Horiz.* (**2016**), 3, 241.
3) Engelberg, P.I. and Tesoro, G.C., *Poly. Eng. & Sci.*, (**1990**), 30, 5.

Acknowledgements

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