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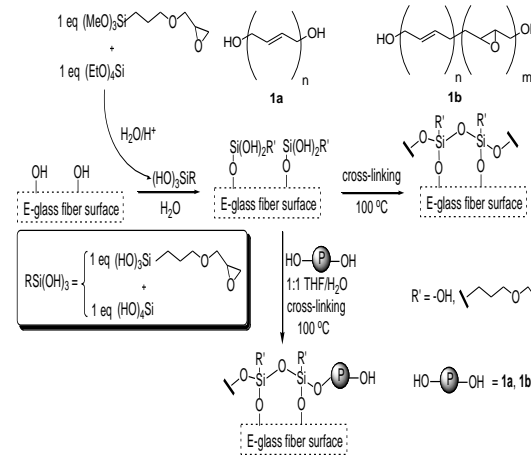
Motivations and Objectives

◆ **Motivation:** Increase energy absorption to improve ballistic properties and increased strength to improve mechanical properties of composite materials.

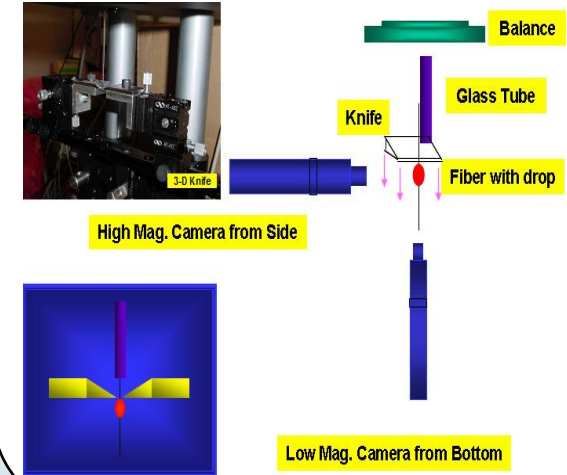
- Old Approach: Control chemical bonding.
- New Approach: Control chemical bonding and texture.
- Prior Research: Silica and soft rubber particles were found to exhibit maximum increase of both energy absorption and strength in E-glass/epoxy composite.

◆ **Objectives:** explore the effects of rubber-type polymers to understand their effect on strength and energy absorption of a composite material.

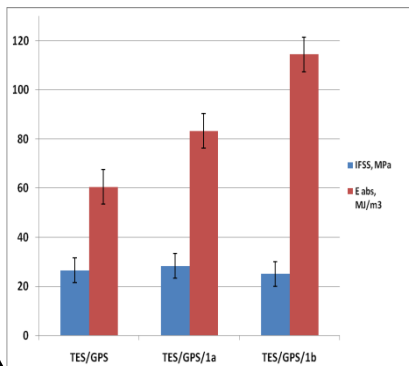
Chemistry of E-Glass Sizings



Microdroplet Testing Apparatus



Microdroplet Test Results

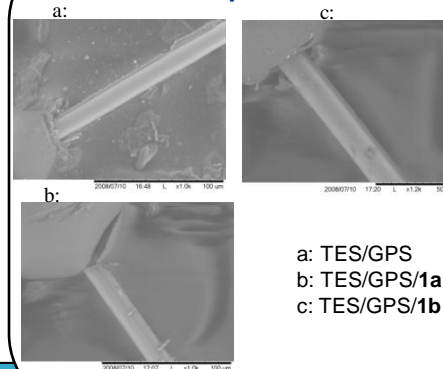


Microdroplet Test Results Cont.

Sample	IFSS, MPa	E ^{deb} , kJ/m ²	E ^{sp} _{ds} , MJ/m ³	E ^{sp} _{gs} , MJ/m ³
GPS/TES	26.52 ± 2.85	1.20 ± 0.41	16.52 ± 2.56	3.52 ± 0.77
GPS/TES/1a	28.39 ± 2.90	1.13 ± 0.37	57.25 ± 5.29	3.91 ± 0.84
GPS/TES/1b	25.10 ± 3.01	1.11 ± 0.49	108.97 ± 8.46	3.98 ± 0.86

◆ **The energy absorbed during the dynamic sliding region increases from the GPS/TES sizing to the GPS/TES/polybutadiene epoxy sizing.**

Microdroplet Failure



a: TES/GPS
b: TES/GPS/1a
c: TES/GPS/1b

Conclusions

◆ Both hydroxyl terminated polybutadiene and hydroxyl terminated polybutadiene /epoxy can be used for sizings for E-glass fiber/epoxy composites.

◆ TES/GPS/1a and TES/GPS/1b maintain composite strength while increasing energy absorption.

◆ The change in the energy absorption due to the debonding and quasi static sliding regions is statistically negligible for TES/GPS, TES/GPS/1a and TES/GPS/1b.

ACKNOWLEDGEMENTS

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