

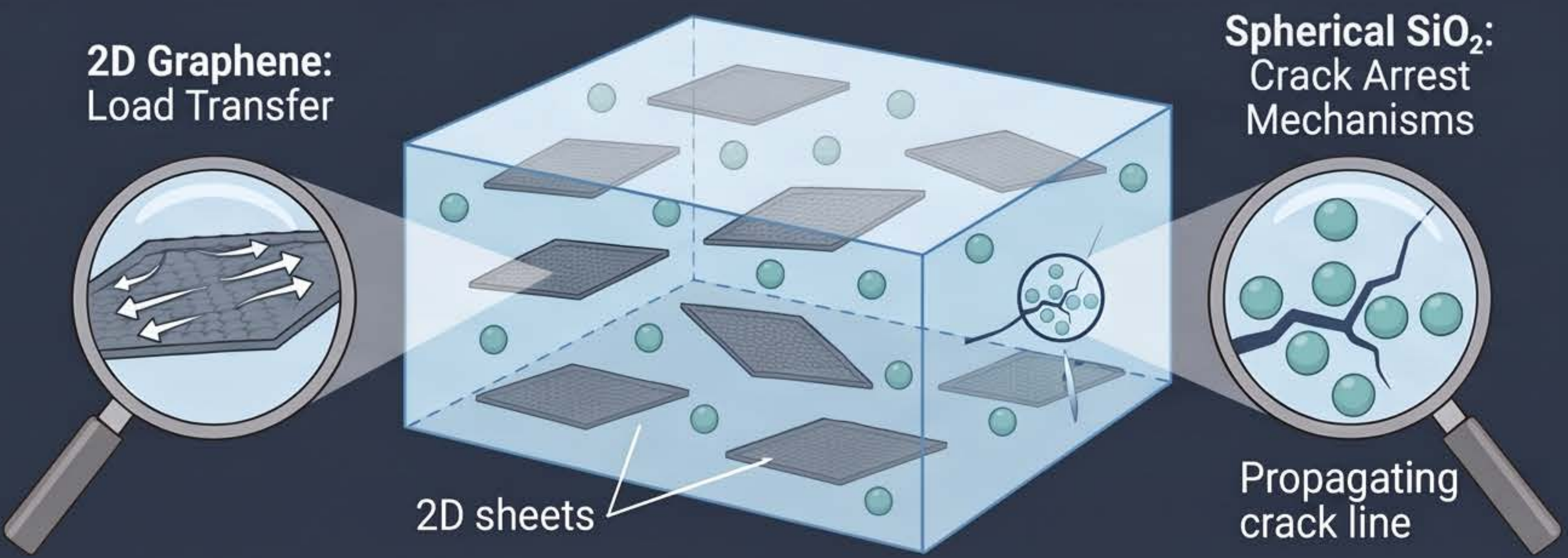
Stronger by Design: Synergistic Reinforcement of Epoxy Nanocomposites

Synthesis & Toughening Mechanisms

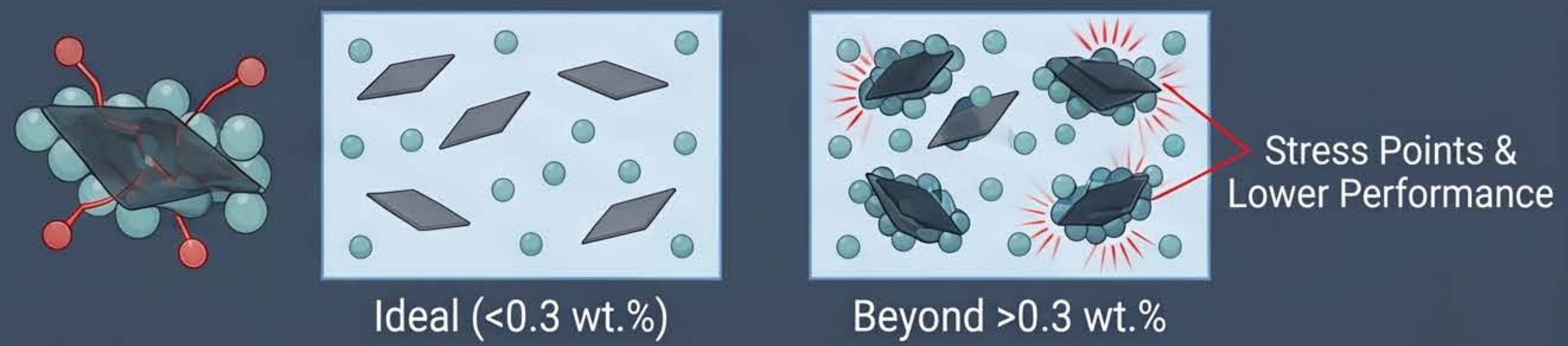
**In-Situ
Polymerisation
& Sonication**



The Hybrid Synergy Effect

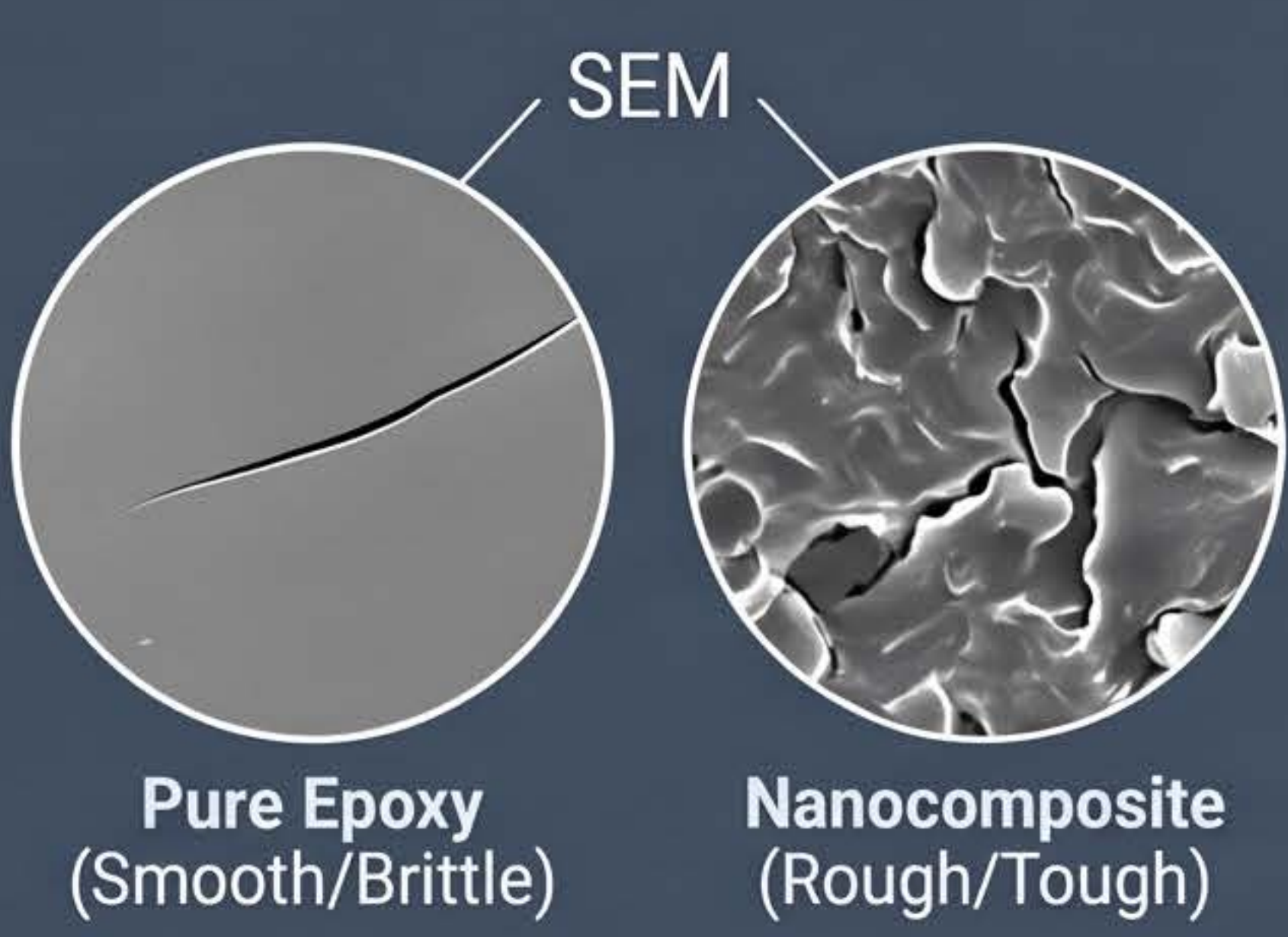


The 'Agglomeration' Threshold

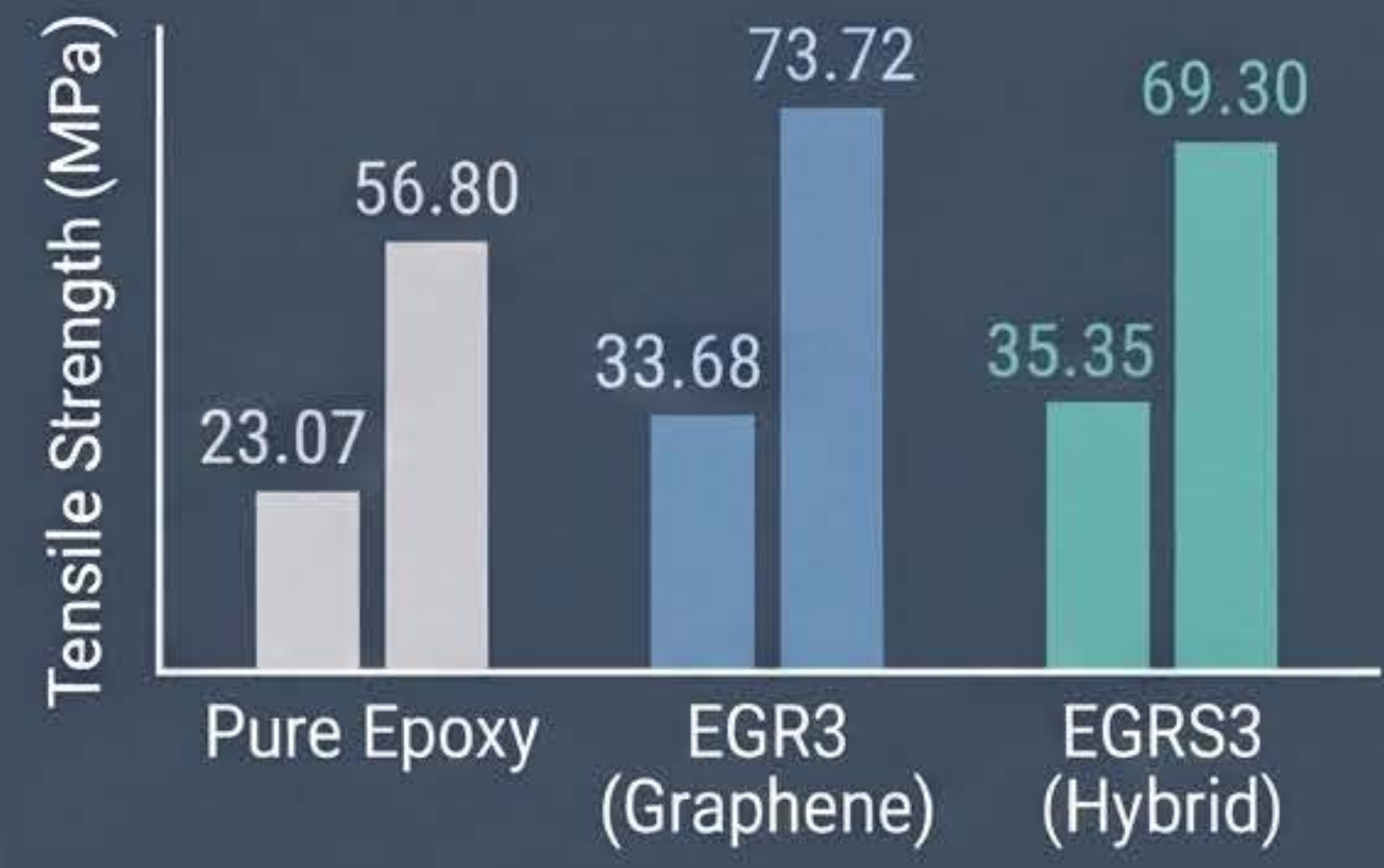


Mechanical Breakthroughs & Performance

**Microscopy:
Validating the Difference**



**53% Increase in
Tensile Strength**

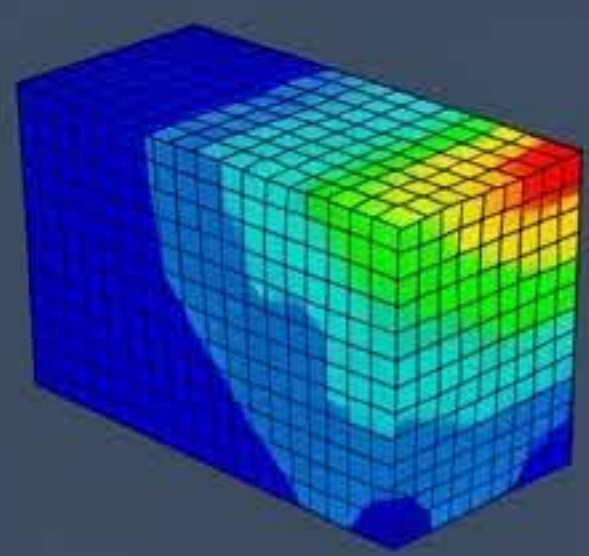


**71% Boost in
Fracture Toughness**

Hybrid fillers (EGRS4) activate multiple energy dissipation mechanisms

Performance Comparison: Neat vs. Nanocomposites

Specimen	Filler Composition	Tensile Strength (MPa)	Flexural Strength (MPa)
Pure Epoxy (PE)	0% Filler	23.07	56.80
EGR3 (Graphene)	0.3 wt.% Graphene	33.68	73.72
EGRS3 (Hybrid)	0.15% G+0.15% S	35.35	69.30



Validated by Simulation
Modelling results matched experimental data within a 1% margin of error.

