Coatings Trends & Technologies SUMMIT

Next Generation Nano-structured Material Derived from Ocean Waste

For Epoxy Applications

Aaron Guan (Founder & CEO)
Neptune Nanotechnologies Inc.

neptune INC NANO TECHNOLOGIES

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Company Overview

- Neptune Nano was founded in 2022 in Toronto
- In house lab and development facilities
- First KG scale pilot plant of it’s kind in the world
- Preoperatory technology with multiple patents filed
- Experienced team in nanomaterial development and commercialization
- Focused on packaging and epoxy industries

neptune INC
NANO TECHNOLOGIES

Neptune Nanotechnologies: Experienced Team

EXECUTIVE TEAM

Aaron Guan
Founder and CEO
- Serial entrepreneur
- Experienced in multiple rounds of million dollar plus raises
- Technology inventor with 7 granted patents
- Forbes 30 Under 30
- Board director of Society of Plastic engineers (SPE TPM&F)
- Rising Star by Plastic News

Winfield Ding
CFO
- CPA, CA
- CFO of Principle Capital Partners
- Former CFO of TSXV public company
- Serves as advisor to several prominent VCs and PEs

Dr. Sara Koul
Sr. Scientist
- PhD in Applied Chemistry from Delhi Technological University
- Former Sr. Scientist at Dow Chemicals
- More than a decade of experience in polymer and composite formulation

PARTNERS & ADVISORS

Dr. Hani Naguib
R&D Partner
- Professor at University of Toronto
- Canada Research Chair
- Director of TIAM

Dr. Sunny Leung
R&D Partner
- Professor at York University
- Director of M3 Labs
- Expert in nanostructured materials

Matthew Diskin
Legal Council
- Partner at Dentons Law
- Expert IP attorney
- Expert corporate & litigation attorney
- Best Lawyers List Canada

Dr. Alex Chen
Advisor
- Founder & CEO of ALCLE consulting
- Clean tech/deep tech business strategist

Constance Wang
Advisor
- Communication and PR strategist
- Web & Social Media specialist

Matthew Powell
IP Advisor
- Sr. Patent Agent
- Expert IP attorney
- IAM Best Lawyer List

Market Trends: Materials Industry

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PERFORMANCE

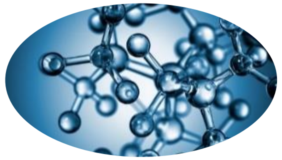
SAFETY

NON-TOXIC

SUSTAINABILITY

Better performance & better sustainability are both mega trends of the material sector

Traditional materials



High performance but environmentally damaging

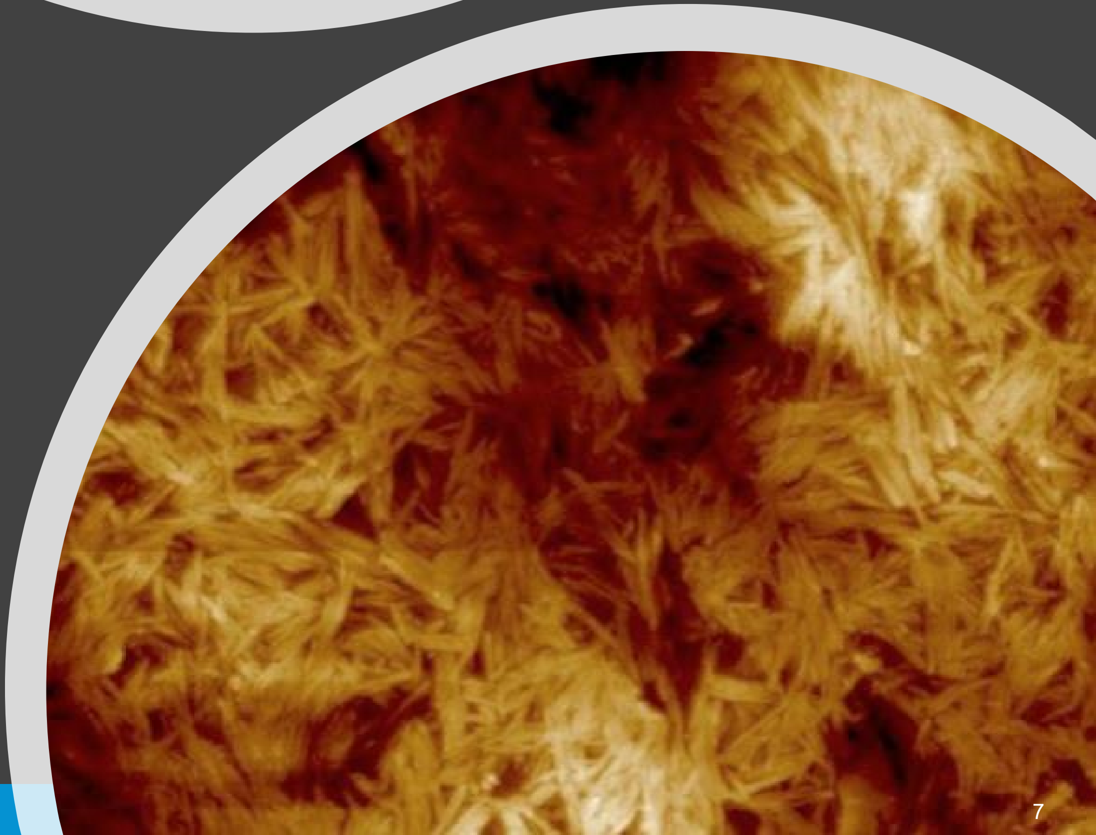
Green materials

Environmentally friendly but poor performance

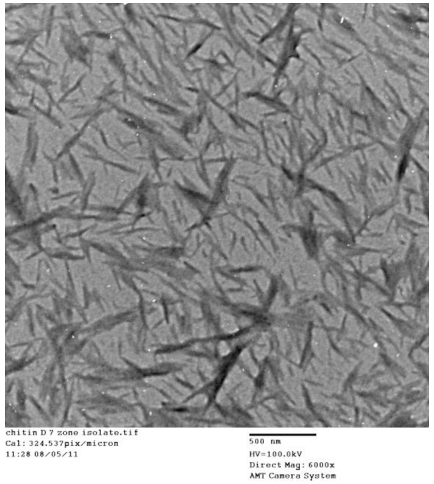
neptune INC NANO TECHNOLOGIES

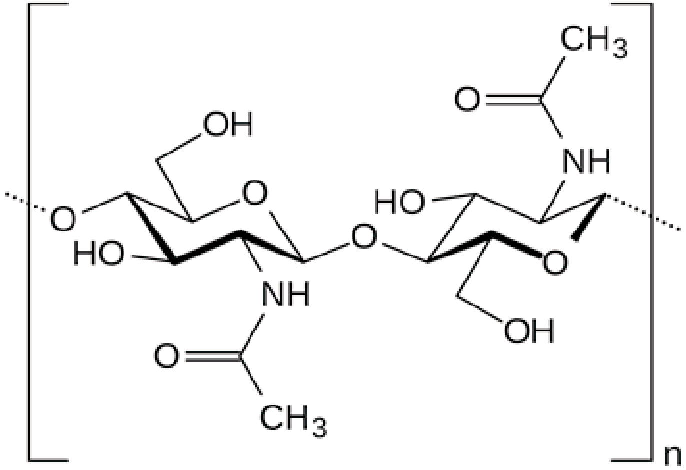
Our Solution:
Chitin Nanocrystal (CNW)

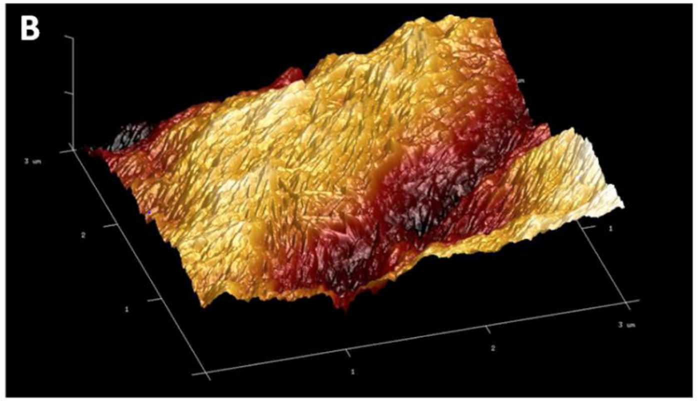
- Synthesized from renewable crustacean shells and fungal cell wall
    - Biobased, biodegradable, biocompatible & non-toxic
- A nano-scale single crystal 10,000X smaller than width of human hair
- Stronger than steel & lighter than plastic
- Used as physical additive, vastly improving material properties in a wide variety of applications
- Higher performance & lower cost than competitors

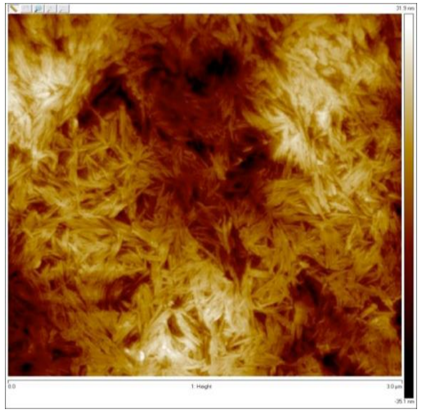


Chitin Nanocrystal (CNW)









CNW nanostructure

Length (nm)	200 - 500
Width (nm)	~20
L : D	(10-25) : 1
SSA (m^2/g)	~300

Pillar 1: Epoxy Applications

Pillar 1: Epoxy Applications

Wind power

Oil & Gas

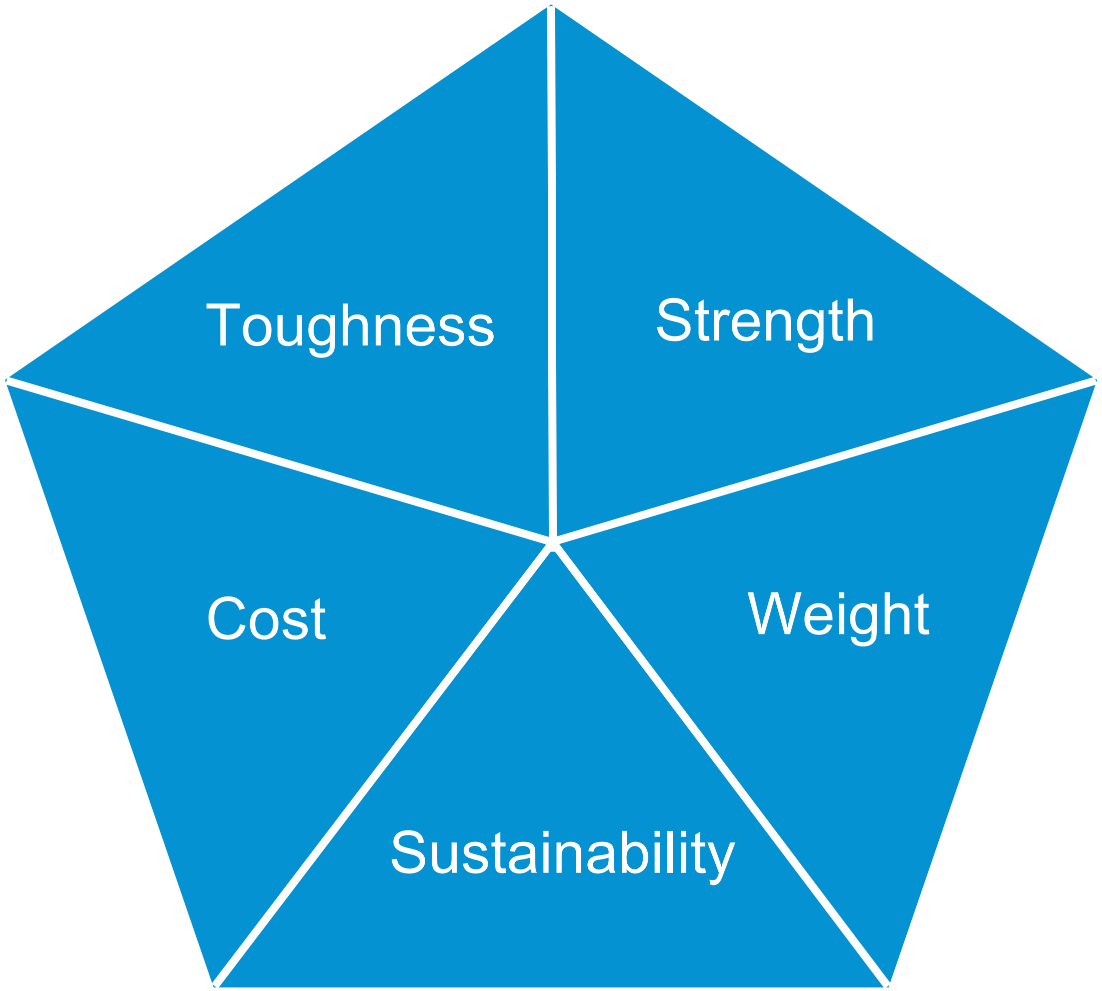
Resins

Aerospace

Fiber composites

Automotive

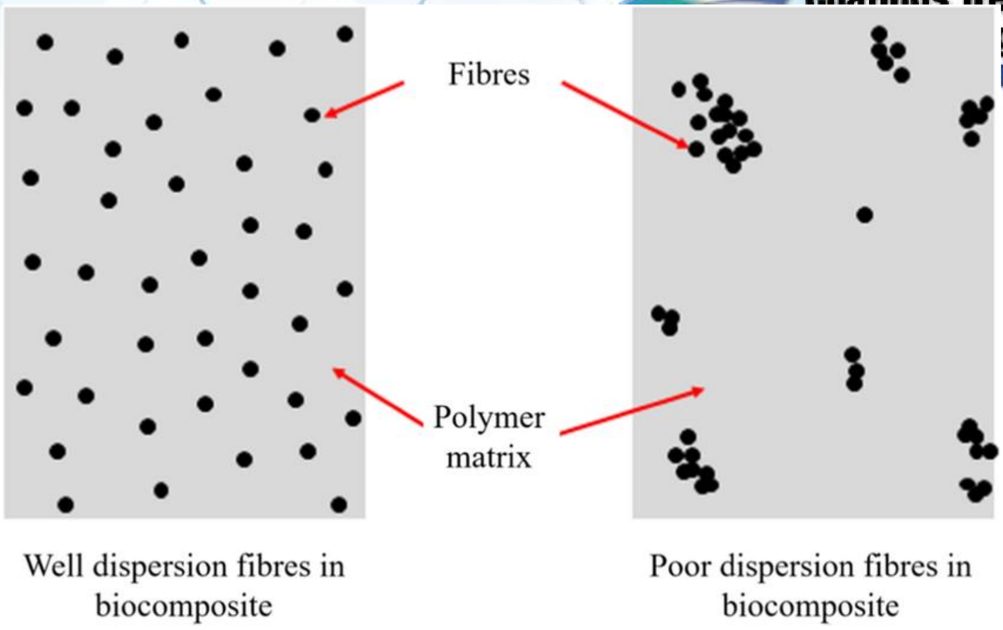
Pain Points: 5 Fundamental Properties of Epoxy



- There are no solution on the market today that can achieve all 5 (only chitin nanocrystals can)
- Incumbent chemical additive solutions lacks strength & sustainability
- upcoming conventional nanomaterial solutions lacks cost & sustainability

Challenges

- 2 major sets of challenges that is faced by nearly all nanocomposites
- Dispersion of the nanoparticle is extremely important
- Poor dispersion leads to agglomeration
- Agglomerated particles are ineffective
- Agglomerated particles can negatively impact performance due to stress concentrations
- Interface compatibility or interface bonding also extremely important
- Incompatible surfaces cannot effectively transfer load
- Fiber pull out, fiber debonding negatively impacts performance

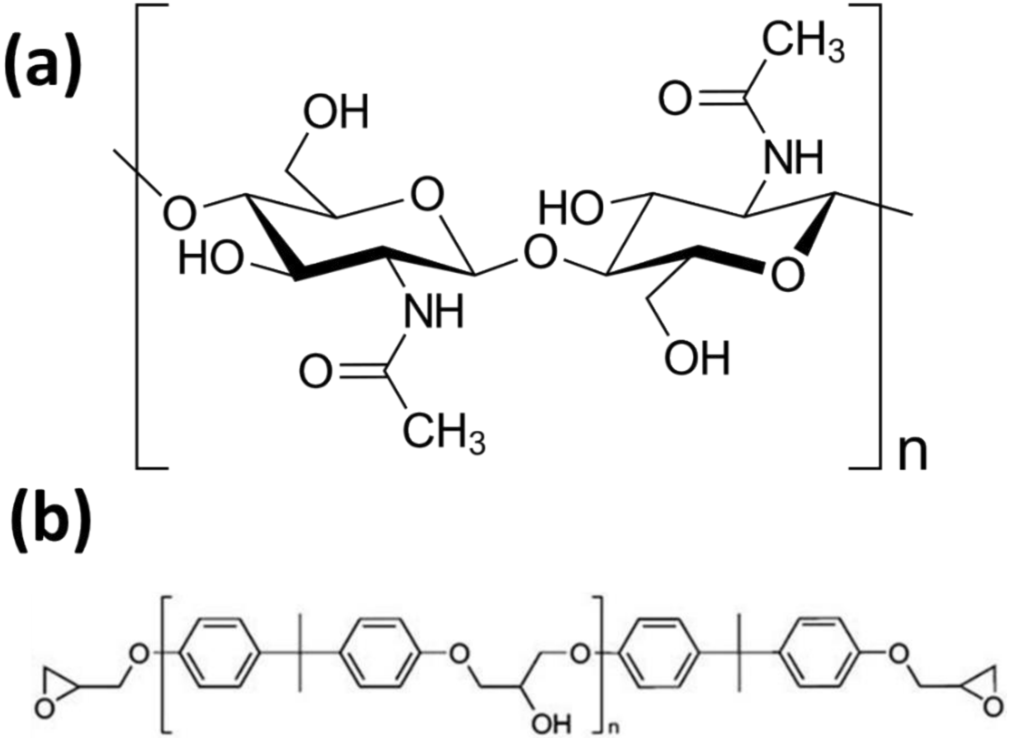


Dispersion of Chitin Nanocrystal

- Dispersion of nanoparticles is challenging in practice
- Dry powder form nanoparticles are difficult to disperse
- Neptune seeks to solve the dispersion challenge by creating chitin nanocrystal in a resin concentrate form
- Carrier resin is from Hexion in this study
- Carrier resin can be customized to most epoxy resins
- Dispersion can be seen due to resin transparency
- Particles size < wavelength of visible light

Interface Compatibility of Chitin Nanocrystal

- Chemical structure of (a) chitin nanocrystals (b) DEGBA epoxies
- The surface chemistry of chitin nanocrystals contains opportunities for both hydrogen& nitrogen bonding
- Epoxies contains epoxide rings that undergo open chain reactions with hydroxyl groups
- This enables covalent bonding between epoxides and chitin's functional groups
- Leads to intrinsic adhesion and load transfer between nanocrystal and epoxy



Materials & Sample Preparation

Materials:

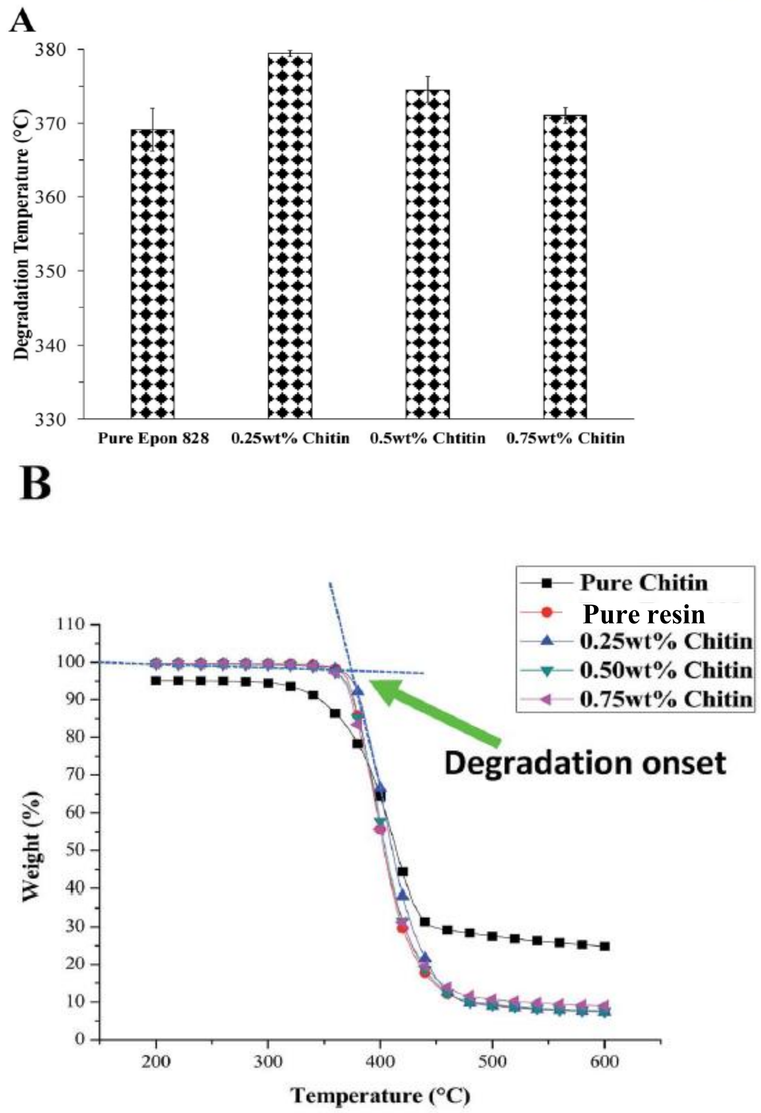
- Hexion resin
- Westlake hardener
- Chitin nanocrystal epoxy concentrate (Commercial name TBD)

Procedure:

- Mix chitin nanocrystal concentrate with resin through simple low sheer mechanical mixing
- Crosslink with hardener under continuous low shear stirring
- Apply degassing process
- Cure in oven at 100C (212F) for 24 hours

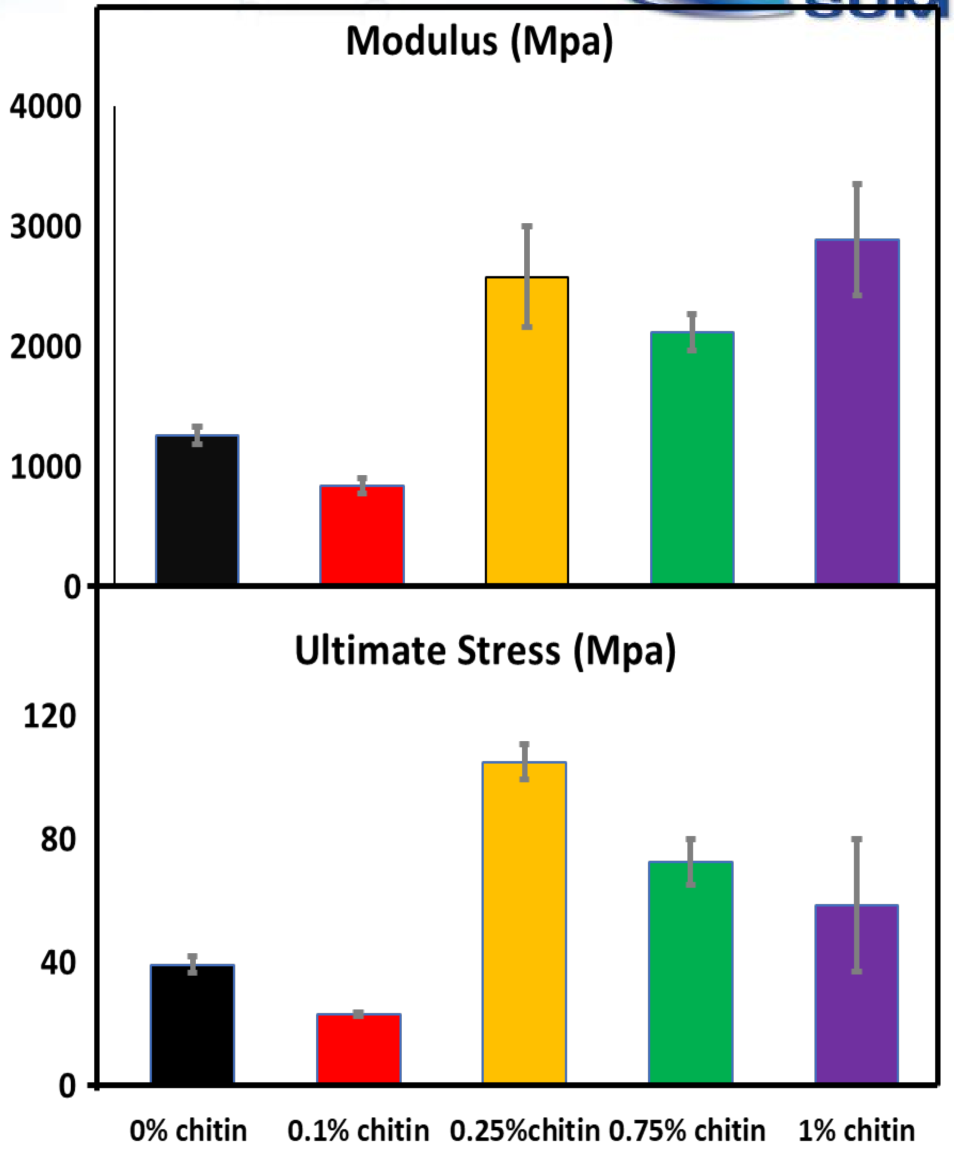
Thermal Properties

- TGA thermal degradation testing conducted
- Onset degradation temperature is 370C for neat epoxy
- Increases to 380C with 0.25% chitin addition
- Tapers off with higher chitin loading levels of 0.5% and 0.75%
- Thermal degradation profiles do not change significantly with the addition of chitin nanocrystal



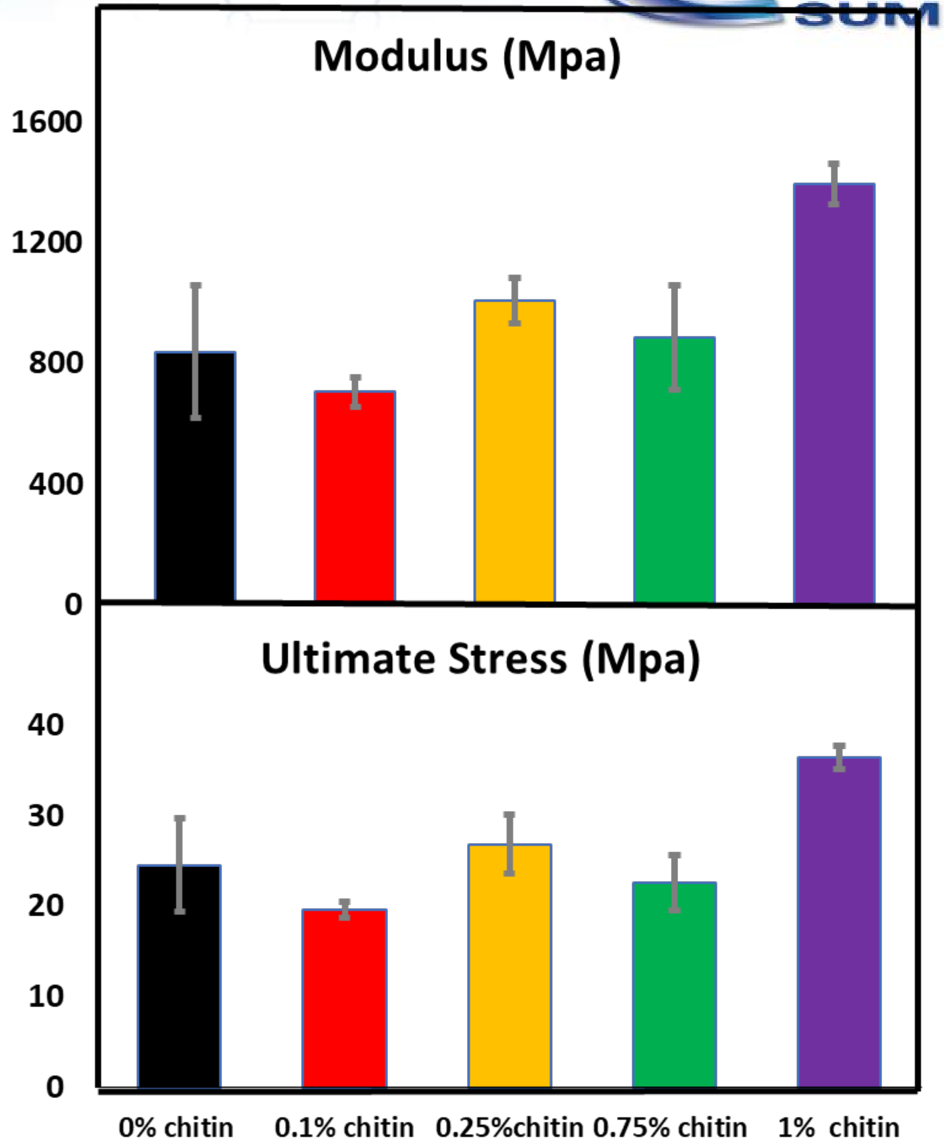
Flexural Properties

- Flexural testing conducted under ASTM D790 standards
- Remarkable increase of 2.5X in both flexural strength and modulus
- Attributed to inherent strength and stiffness of chitin nanocrystal itself
- Also attributed to good dispersion and interface compatibility with epoxy matrix
- Reduction in improvement at higher loading levels likely attributed to agglomerations



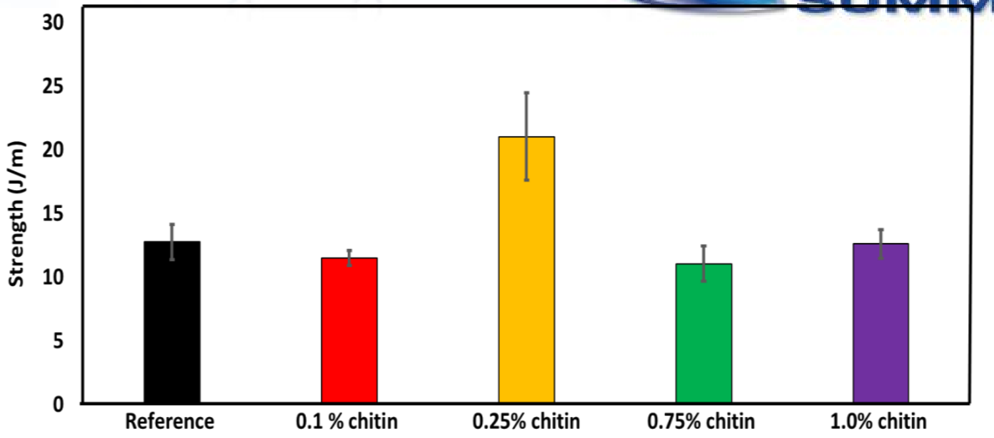
Tensile Properties

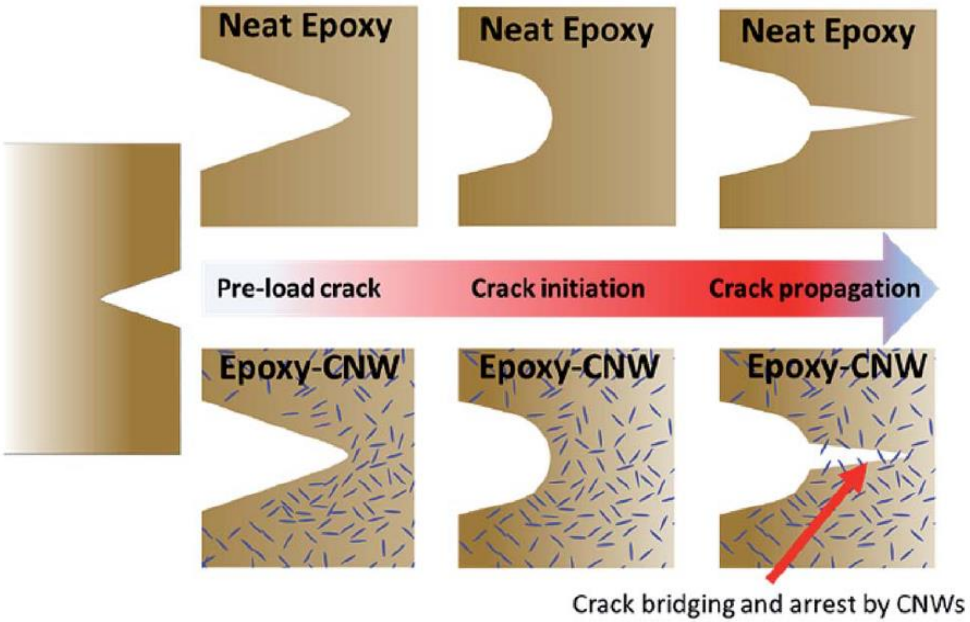
- Tensile testing conducted under ASTM D638
- Notable improvement of 20% in modulus observed at 0.25% loading level
- Minor improvement of 6% in strength observed at 0.25% loading level
- Improvements increases greatly with higher chitin nanocrystal loading levels up to 1%
- Tensile strength improved by 20%
- Tensile modulus improved by 48%



Impact Properties

- Izod impact testing conducted under ASTM D256
- Remarkable 65% improvement in impact strength observed at 0.25% chitin nanocrystal loading levels
- Well dispersed chitin nanocrystals acts as “roadblocks” along crack path
- Extending the crack length of fracture path leading to the consumption of fracture energy
- Crack bridging and arrest also observed





Performance Summary

- Higher strength, lower cost and no VOC emissions compared to chemical additives
- Significantly lower cost and zero toxicity compared to legacy nanomaterials

	Chemical Additives	Legacy Nanomaterials	CNW Nanocrystal
High Strength	X	✔	✔
High Toughness	✔	✔	✔
Low Cost	✔	X	✔
Low Weight	✔	✔	✔
Sustainability	X	X	✔

Performance

Safety

Sampling Today!
Visit our Booth

Non-toxic

Sustainable

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