Magnetically Responsive Silicon Carbide Whiskers for Enhanced Nanocomposite Materials

James Townsend  
Clemson University

Dr. Ruslan Burtovyy  
Clemson University

Dr. Konstantin Kornez  
Clemson University

Dr. Igor Luzinov  
Clemson University

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Magnetically Responsive Silicon Carbide Whiskers for Enhanced Nanocomposite Materials

Jake Townsend, Ruslan Burtovyy, Pavel Aprelev, Konstantin Kornev, and Igor Luzinov

Statement of Work

Macro scale composite materials have been successful by eliminating delamination and introducing designed directionality. Using this same strategy, we plan to enhance nanocomposites through surface modification.

Objectives

1. Modify Magnetic Nanoparticles (MagNP) and Silicon Carbide Whiskers (SiCW)
2. Attach the Modified MagNP to the Modified SiCW
3. Embed and Orient the Functionalized SiCW in an Epoxy Composite Matrix

Methods

1. Modification: “grafting to”
2. Attachment: Polymer-Polymer Complexation

Theoretical calculation for time of rotation for a functionalized SiCW dispersed in an uncured epoxy matrix vs. number of MagNP on surface.

1. Modification

1a) High resolution: γ-Fe$_3$O$_4$-NP grafted PAA
1b) High resolution: SiCW grafted P2VP
From TEM imagining, we can determine the dry thickness of the polymer film which allows us to calculate the grafting density.

\[ \sigma = \frac{h \rho N_A \times 10^{-21}}{M_w} \]

2. Functionalization

From this imagining technique, we can see the surface structure of the MagNP on the SiCW and determine the thickness of the layer on the whiskers.

3. Composite

We can successfully modify, functionalize and embed magnetically active silicon carbide whiskers that will improve the mechanical properties of the nanocomposite system.

Conclusion

Macro scale composite materials have been successful by eliminating delamination and introducing designed directionality. Using this same strategy, we plan to enhance nanocomposites through surface modification.

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