P2: Influence of Particle Functionalization and Curing Conditions on the Microstructure and Surface Roughness of Strontium Hexaferrite Magnetoactive Elastomers

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Magnetoactive elastomers (MAEs) are soft composite materials composed of magnetic nano- or microparticles embedded within polymer matrices, capable of dynamically altering their mechanical behavior in response to external magnetic fields [1,2]. This tunable response makes MAEs highly attractive for applications in soft robotics, adaptive actuators, and vibration damping systems [1–3]. Despite this potential, their broader application remains limited by challenges in reproducibility and a lack of comprehensive understanding of their structure–property relationships.

This study investigates the effects of filler concentration, filler's surface modification, solvent, and magnetic field exposure during curing on the microstructure and surface properties of MAEs based on a polydimethylsiloxane (PDMS) matrix with hard magnetic hexaferrite (HF) fillers. Particular emphasis is placed on reducing particle agglomeration and improving their distribution and compatibility with the polymer matrix. Surface modification of strontium hexaferrite (Sr-HF) microparticles using dodecylbenzene sulfonic acid (DBSA) effectively reduces agglomeration and enhances particle distribution. Furthermore, curing under an external magnetic field promotes some alignment of filler particles, in contrast to the random distribution observed in samples cured without a magnetic field. Across all conditions, surface roughness remains unaffected by external magnetic loading, suggesting that the applied field does not induce a significant surface micro-structure deformation in cured MAEs. By systematically analyzing these effects and optimizing surface-modification strategies, this research aims to advance rational design of MAEs with tailored microstructures, enabling a better understanding of how their internal structure influences their properties and behavior.

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