Effect of Cobalt Particle Morphology on Properties of Magnetorheological Elastomers

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ABSTRACT

The magnetorheological (MR) performance of MR elastomers mainly depends on the types of matrix and magnetic particles. In the past decades, most studies focused on matrix, particles composition, and particle/matrix interface, but few studies analyzed the effect of particles morphologies. Recent studies have shown that the flower-like particles also significantly improves the MR properties of the MR materials.[1-3] However, whether the MR effect of MR elastomers can be enhanced by using flower-like particles as the active phase was left unknown.

In this study, a mechanism model is established to analyze the potential benefits by using flower-like particles as the active phase compared with the conventional sphere particles. To verify the mechanism model and to find the detail difference in dynamic viscoelasticity between the MREs, flower-like cobalt particles and sphere cobalt particles with similar particle size were synthesized and used as the active phase to prepare MR elastomers. Their morphologies, crystal structures, and magnetic properties were analyzed by using SEM, XRD, and VSM, respectively. The morphologies of the particles are shown in Fig.1 and their crystal structures, and magnetic properties are similar. The experimental results indicated the MREs with flower-like cobalt particles present higher crosslink density and enhanced interfacial bond strength, which leads to their higher storage modulus and higher loss modulus with respect to the MREs with sphere cobalt particles, as the model predicted. More meaningfully, the field-induced storage modulus tuneable range was also improved by using flower-like cobalt particles as the dispersing phase. (Fig.2).

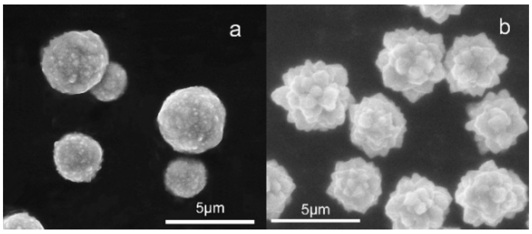

Figure1. SEM image of cobalt particles

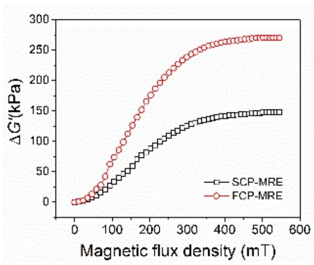

Figure2. Magnetic field induced storage modulus of MREs as a function of magnetic flux density

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