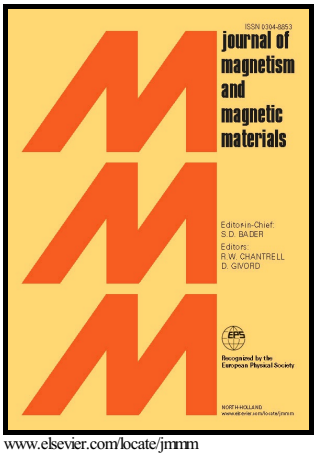

www.elsevier.com/locate/jmmm

Hysteretic behavior of soft magnetic elastomer composites

Maria Krautz, David Werner, Mario Schrödner, Alexander Funk, Alexander Jantz, Jana Popp, Jürgen Eckert, Anja Waske

PII: S0304-8853(16)33025-6
DOI: http://dx.doi.org/10.1016/j.jmmm.2016.11.048
Reference: MAGMA62122

To appear in: *Journal of Magnetism and Magnetic Materials*

Received date: 23 March 2016
Revised date: 10 August 2016
Accepted date: 10 November 2016

Cite this article as: Maria Krautz, David Werner, Mario Schrödner, Alexander Funk, Alexander Jantz, Jana Popp, Jürgen Eckert and Anja Waske, Hysteretic behavior of soft magnetic elastomer composites, *Journal of Magnetism and Magnetic Materials,* http://dx.doi.org/10.1016/j.jmmm.2016.11.048

Hysteretic behavior of soft magnetic elastomer composites

Maria Krautz[a], David Werner[a], Mario Schrödner[b], Alexander Funk[a], Alexander Jantz[b], Jana Popp[b], Jürgen Eckert[a,c,d], Anja Waske[a]

[a]Institute for Complex Materials, IFW Dresden, P.O. Box 270116, D-01171 Dresden

[b]Thuringian Institute of Textile and Plastics Research e.V., Breitscheidstraße 97, D-07407 Rudolstadt, Germany

[c]Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Jahnstraße 12, A-8700 Leoben, Austria

[d]Department of Materials Physics, Montanuniversität Leoben, Jahnstraße 12, A-8700 Leoben, Austria

Abstract

Composites of polymer and micron-sized particles of carbonyl-iron were investigated in terms of their magnetization behavior. Thermoplastic elastomers with varying Young's modulus ($E_{Polymer}$ = 0.14 - 14.6 MPa) were used as matrix material. Field dependent magnetization curves reveal that the hysteretic behavior of the composites strongly depends on both the particle fraction (7, 10, 14, 21, 31 vol%) and on the mechanical properties of the polymer. It is shown that hysteresis only appears above a certain fraction of magnetic particles which can be accounted to the magnetic exchange between the particles. However, hysteresis is suppressed in the composite with largest Young's modulus of the polymer matrix, even at largest particle fraction.

Keywords: soft magnetic composite; particle-matrix-interaction; magnetoelastic compound; magnetic elastomer

1. Introduction

Magnetoelastic composites based on an elastic polymer matrix and a magnetic material have attracted attention in various research fields, such as sensor technology, damping mechanics or biomedicine. These materials are highly responsive to an externally applied magnetic field triggering the change of intrinsic and extrinsic properties, like size and shape, permeability, magnetization or mechanical behavior [1,2]. For application, usually magnetostrictive and magnetorheologic effects of these composite materials are exploited [3,4]. The internal structure can be manipulated by an external magnetic field during preparation as has been shown experimentally [5,6]. The resulting microstructure strongly influences the properties of such composites [7]. Several numerical studies have been applied to model the coupling between magnetic particles and