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Magnetostrictive Composites

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5.26.1 INTRODUCTION

Magnetostrictive particle composites are formed by incorporating powdered magnetostrictive material at volume fractions ranging from under 2% to over 98% of powered magnetostrictive material in a metal, glass, polymeric, and/or rubber matrix. Rubber matrix based particle composites are also called magnetostrictive elastomers. Magnetostrictive bimorph composites are formed by bonding together two lamina that exhibit different magnetostrictive characteristics. The ability of magnetostrictive composites to efficiently convert magnetic to mechanical energy and vice versa makes them attractive for use as the transduction element in a variety of actuators and sensors.

In 1983, Clark and Belson (1983) identified several magnetostrictive composites including a 50% volume fraction composite of $TbFe_2$–EPON-815 epoxy resin that exhibited magnetostriction of 1777 ppm at room temperature. Unlike their piezoelectric and ferroelectric composite counterparts (smart materials that typically cost less but exhibit significantly lower strains), the magnetic attributes of magnetostrictive composites readily facilitate their use in noncontact sensor applications, such as might be required for rotating systems. Applications for magnetostrictive composites range from use as a replacement for bulk magnetostrictive materials to achieve ultrasonic frequency performance (Sandlund and Cedell, 1992) to novel health monitoring applications in which low-density magnetostrictive tagging