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Hysteresis And Magnetoelastic Domain Wall Behavior of Two

JACOB HOBERG, JASON ORRIS, GREGORY SOLLENBERGER, DOUG FRANKLIN, MARK BOLEY, Western Illinois University — We have produced torque sensors from type A-2 and type H-13 tool steels for torque transfer applications in a 0.75 inch outer diameter hollow shaft by magnetically polarizing two adjacent sections with oppositely directed circumferential magnetization. The resultant field signal, found to be linear with applied torque up to 15 N-m, emanated from the domain wall formed between the two regions. Heat treatment resulted in an increase in torque-load sensitivity (field signal in μG per unit applied shear stress in psi) from 48.2 μG/psi to 59.2 μG/psi in the A-2 sample and from 125 μG/psi to 189 μG/psi in the H-13 sample, improved linearity of the signals, and a more reliable re-zeroing of the sensors following removal of the applied torque. The axial coercive forces were found to decrease prior and subsequent to heat treatment, with the percent of decrease in correlation to the percent of increase in the sensitivities found above, while the circumferential coercive forces were sufficiently large to guarantee integrity of the magnetically polarized regions comprising the sensor. The width and magnetic intensity of the domain wall in each sensor were also measured using the technique of magnetic force microscopy.

Doug Franklin
Western Illinois University

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