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The Dependence of Sensitivity, Axial Coercivity, and Domain Wall Height on Chromium Concentration in Polarized Steel Alloy Torque Transducers RYAN GORDON, JASON ORRIS, JASON WILSON, DOUG FRANKLIN, MARK BOLEY, Western Illinois University — We have discovered that a large enhancement in the sensitivity of magnetically polarized steel torque transducers can be gained by increasing the chromium concentration of the steel to as high as the 12% level (with nickel concentrations under l%), without the sacrifice of any essential mechanical properties. Beyond this optimal concentration level, the enhancement in the sensitivity appears to have saturated and then gradually disappears as additional chromium is added. Among the steel shafts we investigated were four with respective chromium concentrations of 0.15%, 3.5%, 12.0%, and 25.5%, that are correspondingly known as steel types W-1, S-7, D-2, and F-255. Their transducer sensitivities were found as 3.1, 54.2, 97.7, and 19.3 μG/psi, respectively. Correspondingly, the area of the axial hysteresis curves for the first three of these steels dramatically decreased as the chromium concentration went up to the 12% level, and then gradually increased again as additional chromium was added. Using the technique of magnetic force microscopy, we also determined that the heights of the center domain wall between the two magnetically polarized regions were directly correlated to the observed sensitivities.

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