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Effect of Low Nickel Dopant on Torque Transducer Response Function in High-Chromium Content ESR Stainless Tool Steels JOSEPH L. WIEWEL, BRYAN G. HECOX, JASON T. ORRIS, MARK S. BOLEY, Department of Physics, Western Illinois University, Macomb, IL — The change in magnetoelastic torque transducer response was investigated as a low nickel content (up to 0.2%) is alloyed into an ESR (Electro-Slag-Refining) stainless tool steel with a chromium content of around 13%, which our previous studies have proven to be the ideal level of chromium content for optimal transducer performance. Two separate hollow steel 3/4-inch diameter shafts were prepared from ESR 416 and ESR 420 steel, respectively, the first having no nickel content and the second having 0.2% nickel content. The heat treatment of these steels consisted of a hardening process conducted in a helium atmosphere at 1038°C, followed by an annealing at 871°C for 5h and a 15°C cool down rate. Prior and subsequent to the heat treatment processes, the circumferential and axial magnetic hysteresis properties of the samples were measured and their external field signals were mapped over the magnetically polarized regions both with and without applied shear stress up to 2500 psi on the samples. It was found that the effect of the low nickel dopant was to improve torque transducer sensitivity and linearity, but heat treatment worsened the performance of both samples.

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