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Layered Magnetic Thin Films for High Susceptibility WILLIAM EGELHOFF, MARK STILES, FRANK JOHNSON, ALEX SHAPIRO, P.J. CHEN, CED POWELL, NIST, ROBERT MCMICHAEL, NIST — Thin-film magnetic sensors require sense layers with high magnetic susceptibility in order to achieve high sensitivity to low magnetic fields. We have carried out an extensive investigation into a variety of soft magnetic materials including varieties of Permalloy and mu-metal, depositing them by both magnetron and ion-beam sputter deposition. We have found that two of the most important characteristics for achieving high susceptibility are the use of metallic seed layers and layering the magnetic films with non-magnetic films. Some of the best results come from using two layers of the mu-metal alloy known as Co-netic (each film several tens of nm thick) with a 10 nm Cu film as a seed layer and spacer layer. In such samples, we have been able to achieve susceptibilities of $\sim$100,000 and hard-axis coercivities of 0.12 A/m $\pm$ 0.12 A/m (0.0015 Oe $\pm$ 0.0015 Oe). Such films should provide excellent sensitivity to very small magnetic fields when used as the sense layer in magnetic tunnel junctions.

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