1996

Suppression of biquadratic coupling at the Cr Néel temperature in Fe/Cr(001) superlattices (invited) (abstract)

Eric E. Fullerton
Argonne National Laboratory

Shireen Adenwalla
University of Nebraska-Lincoln, sadenwalla1@unl.edu

G. Felcher
Argonne National Laboratory

C. H. Sowers
Argonne National Laboratory

S. D. Bader
Argonne National Laboratory

See next page for additional authors

Suppression of biquadratic coupling at the Cr Néel temperature in Fe/Cr(001) superlattices (invited) (abstract)

Eric E. Fullerton, S. Adenwalla, G. Felcher, C. H. Sowers, and S. D. Bader
Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439

J. L. Robertson
Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennesee 37831-6393

A. Berger
Department of Physics, University of California at Irvine, Irvine, California 92717

We present the effects of antiferromagnetic (AF) order of the Cr spacers in Fe/Cr(001) superlattices on the interlayer coupling of the Fe layers. AF order of the Cr spacers is suppressed for layer thicknesses less than 42 Å. For >42 Å of Cr, the Néel temperature (T_N) increases rapidly and asymptotically approaches the bulk value for thick Cr spacers as characterized by a transition-temperature shift exponent $\lambda = 1.4 \pm 0.3$. Neutron diffraction confirms both the AF order of the Cr layers in superlattices with 62, 100, and 200 Å thick Cr layers, and the existence of the incommensurate, transverse spin-density-wave magnetic structure whose nesting wave vector is equal to that of bulk Cr. The AF ordering of the Cr results in anomalies in a variety of magnetic properties, including the interlayer coupling, remanent magnetization, coercivity, and magnetoresistance. Most strikingly, the 90° or ''biquadratic'' coupling of the Fe layers observed for $T > T_N$ is suppressed below T_N as confirmed by polarized neutron reflectivity. This behavior can be understood in terms of the combination of finite-size and spin frustration effects at rough Fe/Cr interfaces. [S0021-8979(96)58608-9]

Work at ANL supported by the U.S. Department of Energy, Basic Energy Sciences-Materials Sciences, under Contract No. W-31-109-ENG-38. Work at ORNL supported by the U.S. Department of Energy, the Division of Materials Sciences, under Contract No. DE-AC05-84OR21400.

 0021-8979/96/79(8)/4524/1/$10.00