Diffraction Physics II - Magnetic Structures with Neutron & Synchrotron Radiation

MS15.02.01 NEUTRON AND X-RAY SCATTERING STUDIES OF THIN FILM ALLOYS AND MULTILAYERS M. B. Salamon*, Department of Physics, University of Illinois at Urbana/Champaign,

The growth of magnetic materials by molecular beam epitaxy results in synthetic crystals with novel properties induced by the periodic variation of composition, and by the physical constraints imposed by coherency strains and epitaxial clamping to a substrate. Among the most dramatic effects is the observation of long-range coupling of transverse helical magnetization and longitudinal sinusoidal modulation through non-magnetic materials such as Y and Lu. As first step in measuring directly the induced magnetization, we have demonstrated that resonant x-ray scattering is capable of detecting a spin-polarization of the order of 0.1 (μ_B/atom on non-magnetic atoms in alloys where the dominant magnetization is 100 times larger. Attempts to detect these effects in superlattices of Dy and Lu and Ho and Lu are complicated by magnetostrictive effects and changes in the intensity of superlattice Bragg peaks on passing through an absorption edge. A second thrust of our research is directed toward control of structure through epitaxy. We will demonstrate the stabilization of the dhcp phase of a NdY alloy in the composition range where the Sm structure is the equilibrium phase. Surprisingly, we have found that the helimagnetic phase present in the alloy persists in superlattices, where it competes with the complex basal-plane ordering of Nd.

Temporary address: *Center for Materials Science, MS K765, Los Alamos National Lab, Los Alamos, NM 87545

MS15.02.02 NEUTRON AND X-RAY SCATTERING STUDIES OF RENi2B2C SUPERCONDUCTORS. Alan I. Goldman

MS15.02.03 NEUTRON DIFFRACTION STUDIES OF HYBRIDIZATION AND ANISOTROPY IN URANIUM INTERMETALLIC COMPOUNDS. R. A. Robinson, Los Alamos National Laboratory, Los Alamos, NM 87545

We discuss the application of powder and single-crystal neutron diffraction techniques to the problem of hybridization between the uranium f-electrons and transition-metal d-electrons in uranium intermetallics. In recent years, a simple phenomenological picture has emerged in which the magnetic anisotropy is closely related to the bonding anisotropy and by inference, anisotropy in the hybridization. As a rule, the uranium moments tend to lie perpendicular to directions or planes containing nearest uranium neighbours. While this works very well in most cases studied to date, a few exceptions are beginning to emerge. Most notable are the cases of the noncollinear antiferromagnets UPdSn (space group $P6_3mc$) and UNiGe (space group Pnma), which have been studied using a battery of neutron techniques (powder, Rietveld refinement, single crystal at spallation source and reactor, polarised neutrons, measurements in horizontal and vertical fields), as well as the complementary technique of bulk high-field magnetization. Symmetry techniques (Shubnikov groups and Irreducible representations) have also been heavily exploited and we will discuss their application to this problem, particularly the magnetic implementation in the Rietveld package, GSAS.

MS15.02.04 NEUTRON AND X-RAY SCATTERING STUDIES OF THE SPIN-PEIERLS TRANSITION IN $CuGeO_3$ Kazuma Hirota, Physics Department, Tohoku University, Sendai 980-77, Japan

In 1993, Hase *et al.*[1] reported that an inorganic linear Cu^{2+} ($S = 1/2$) chain compound $CuGeO_3$ undergoes a spin-Peierls (SP) transition, which had been previously known only in several organic compounds. Since this simple inorganic oxide gives us the first chance to fully understand the detailed mechanism of this phase transition into a singlet state, it is not surprising that $CuGeO_3$ has attracted much attention from researchers in a variety of fields. Among many kinds of measurements, neutron and x-ray scattering techniques and their combination have been playing a central and significant role in its research, and in fact found two most crucial evidences of an SP transition, i.e., the singlet-triplet excitation[2] and the dimerization along the chain[3]. $CuGeO_3$ is, however, significantly different from organic SP compounds in two aspects, which are the lack of a good one-dimensionality in the magnetism ($J_c : J_b : J_a \sim 1 : 0.1 : 0.01$) [2] as well as no obvious phonon softening at the dimerization q vector (1/2, 1, 1/2)[4]. Both of them had been considered necessary conditions for an SP transition in the course of studying organic systems. We will discuss recent neutron and x-ray scattering experiments with referring to a possible mechanism which realizes the SP transition in $CuGeO_3$.

[1]M. Hase *et al.*, Phys. Rev. Lett. **70**, 3651 (1993)
[2]M. Nishi *et al.*, Phys. Rev. B **50**, 6508 (1994)
[3]K. Hirota *et al.*, Phys. Rev. Lett. **73**, 736 (1995)
[4]K. Hirota *et al.*, Phys. Rev. B **52**, 15412 (1995)