MS12.03.03 SURFACE LAYERING OF A MAGNETIC FLUID STUDIED BY X-RAY REFLECTIVITY. Isao Takahashi, Yasunori Tsukahara†, Koichi Akimoto†, and Ayahiko Ichimiya†, School of Science, Kwansei Gakuin University, Uegahara, Nishinomiya 662, Japan, Department of Quantum Engineering, Nagoya University, Chikusa-ku, Nagoya 464, Japan

X-ray surface scattering measurements on a free surface of a magnetic fluid were performed at various temperatures from 250K to 450K. The former temperature is close to the freezing point and the latter is near the decomposition temperature of the disperse medium. All reflectivity data, collected to momentum transfer as large as Q (= $4\pi\sin\theta/\lambda$) = 0.15Å^{-1}, exhibit a broad maximum near 0.06Å^{-1}. This indicates a layer spacing which is comparable to the size of the mean value of the magnetic fine particles.

In the present study, an analysis was carried out based on kinematical scattering theory by adopting two steps: direct Fourier transformation from the reduced intensity to a density-gradient convolution function; followed by non-linear least squares fitting. In the second process, from the convolution function, we can obtain the electron density function. At 300K, the magnitude of the electron density oscillations decays with a characteristic length of 51Å. In addition, the amplitude of the first peak at the surface is $1.9\rho_0$. This is much larger than that of monoatomic liquids like Hg or Ga. Surface effects of this interesting colloidal solution will be discussed through the temperature variation of the electron density function.

MS12.03.04 INVERTING SPECULAR NEUTRON REFLECTIVITY. C. F. Majkrzak and N. F. Berk, Materials Science and Engineering Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899-0001, USA

Recent progress has been made in the problem of measuring the phase of neutron reflectivity, thereby opening new possibilities for the analysis of specular reflectometry, including the determination of scattering length densities by direct inversion of data. We describe two approaches which we have recently developed.

In one [1] both the complex reflection coefficient and the measured reflectivity are shown to be expressed by the same three functions of the elements of a 2X2 transfer matrix. These functions are measurable from the reflectivity spectra of three samples, each consisting of the same unknown film and one of three known reference layers. While this method requires three measurements, it entails only algebraic and local extraction of the reflection amplitude, the phase determination at each wavevector depending only on data at that point.

A second method [2] uses a single reflectivity spectrum but is restricted to mirror symmetric films, i.e., films which present the same scattering length density profile from either direction. Often such potentials may be formed by abbutting identical specimens of the film of interest. The phase of reflection for symmetric potentials of known, finite length is determined by the phase of transmission, which is recoverable from the reflectivity using a logarithmic dispersion relation.

Knowledge of the complex reflection coefficient enables direct inversion of neutron reflectometry using the Gel'fand-Levitan-Marchenko integral equation or related methods. Examples will be discussed.

[1] C.F. Majkrzak and N.F. Berk, Phys. Rev. B 52, 10827 (1995).
[2] N.F. Berk and C.F. Majkrzak, J. Phys. Soc. Japan, to be published.

MS12.03.05 BACK-REFLECTION X-RAY STANDING WAVE STUDIES OF ADSORBATES ON METAL SURFACES. By L.E. Berman*, D. Heskett**, X. Shi**, C. Su**, P. Xu**, J. Warner**, C. Kao*, M.J. Bedzyk***, *NSLS, Brookhaven National Lab., Upton, NY 11973, **Dept. of Physics, U. Rhode Island, Kingston, RI 02881, ***Dept. of Mater. Sci.& Eng., Northwestern U., Evanston, Il. 60208 and Mater. Sci. Div., Argonne National Lab., Argonne, Il. 60439

We have carried out x-ray standing wave studies of the registry of the diatomic molecule CO on Ni, and the alkali atom Rb on Cu, single crystal surfaces. The x-ray standing wave technique is a powerful method for the determination of the positions of atoms and molecules on single crystal surfaces. The dynamical x-ray diffraction conditions that are required to form the standing wave field necessitate the use of perfect crystals, of which there exist relatively few with very small mosaic spread and little static disorder. Near the back-reflection condition (Bragg angle close to 90 deg), however, the intrinsic dynamical diffraction reflectivity width exceeds 1 deg for many crystal Bragg reflections, which greatly expands the range of crystals for which the x-ray standing wave technique is applicable, and has made our measurements on Ni and Cu crystals (each with a mosaic spread of 0.25 deg) possible. In the case of adsorption of a submonolayer of CO on a Ni(111) surface, the positions of the C and O atoms can be probed separately, giving the bond length of the diatomic molecule. Photoemission signals arising from each constituent, as well as from the Ni substrate, were measured separately as two different Bragg reflections were scanned. We determined a C-O bond length of 1.10(.06) Å with the molecular axis assumed to be oriented perpendicular to the surface. A model in which the CO adsorbs in a 50-50 mixture of 3-fold fcc and hcp hollow sites, with the C atom closer to the substrate, compares favorably with the data. We also studied the adsorption of Rb submonolayers on Cu(111) and (110) surfaces. For the Cu(111) case, we determined that the Rb atom preferentially adsorbs in the top site, at a fixed vertical height but with substantial lateral disorder. For the Cu(110) case, which has an alkali-induced (1x2) missing row reconstruction, we found the Rb atom to sit in a fixed vertical position and well localized laterally perpendicular to the missing rows, but highly disordered along the rows.

MS12.03.06 DEPTH SELECTIVE ANALYSIS OF BURIED SEMICONDUCTOR LAYERS USING X-RAY GRAZING INCIDENCE DIFFRACTION. U. Pietsch, D. Rose, Institute of Solid State Physics, University of Potsdam, Germany

The X-ray grazing incidence diffraction method (GID) is a powerful tool to investigate crystalline near suface regions in the depth between 5 and 400 nm. The method was applied on a number of GaAs/(GaIn)As/GaAs[001] single quantum well structures prepared by MOVPE. The thickness of the buried SQW was varied between one monolayers and 5 nm. The experiment was performed at the D4 beamline at HASYLAB using $\lambda \approx 1.33$ Å. At the angular position of the in-plane (200) reflection and setting the angle of incidence α_i fixed the intensity distribution of the diffracted beam was recorded as a function of the exit angle with respect to the sample surface, α_f, (crystal truncation rods - CTR) using a position sensitive detector. Besides the "surface peak" at $\alpha_f = \alpha_c$ (critical angle of total external reflection), CTR- oscillations appear which measure the thickness of the GaAs top layer. As verified by computer simulation the modulation contrast depends on the thickness of the SQW and the perfection of the GaAs/InAs interfaces. Recording CTR's at different α_i the indium concentration can be obtained as a function of depth. We found that none of the samples had sharp interfaces. The indium atoms are spread over 3 -5 monolayers. They occupy the sites along 2D terraces. For thicker SQW (5 nm) we could verify that at least one of both interfaces is graded but the other remains sharp.

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