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 $Q = 0.15 \text{Å}^{-1}$, 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 discuss through the temperature variation of the electron density function.

Recent progress has been made in the problem of measuring the phase of neutron reflectivity, thereby opening new possibilities for the analysis of speculative 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 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 abutting identical potentials.

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.

References: