Neutron imaging and grating interferometry for material science

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Recent advancements have demonstrated that a shearing-type interferometer, utilizing precision silicon gratings, enables imaging of the gradient of neutron phase shifts through an object, with phase retrieval achieved by simple one-dimensional integration of the gradient. To explore the potential of this technique for future cold neutron imaging stations at the Korea Atomic Energy Research Institute (KAERI), we have developed several prototype grating systems and demonstrated its capability.

Initially, silicon gratings were designed and fabricated using evaporation or sputtering of Gd for source and analyzer gratings. However, the introduction of the Gd-powder filling method has significantly simplified and enhanced the flexibility of the fabrication process. Consequently, a variety of neutron grating designs, each optimized for different parameters such as resolution, sensitivity, and autocorrelation length, have been tested at the newly built cold neutron imaging facilities at NIST and PSI.

In addition to hardware developments, we will present several intriguing material applications derived from this work, along with novel data processing techniques that leverage machine learning.