Low-temperature magnetic resonance force microscopy probe for easy sample exchange

Soonho Won[1*], Seung-Bo Saun[2], and Jinhee Heo[1]
[1]*Department of Materials Modeling & Characterization, Korea Institute of Materials Science, Changwon 51508, Republic of Korea*
[2]*Western Seoul Center, Korea Basic Science Institute, Seoul 03759, Republic of Korea*
e-mail address: wsh@kims.re.kr

Since G. Binning developed the atomic force microscope, many kinds of similar force microscopes have been developed. Magnetic resonance force microscopy (MRFM) is one of them. The concept of MRFM was first proposed by J. Sidles of the University of Washington in 1991 and first experimentally demonstrated by D. Rugar et al. of the IBM Research Division, Almaden Research Center. MRFM is a breakthrough device that dramatically improves the spatial resolution of magnetic resonance, making it possible to perform magnetic resonance measurement in the nano-meter area, which was previously impossible. Unfortunately, no formal products have yet been launched. Therefore, the MRFM that is currently being announced is a self-developed product by an individual laboratory.

In this study, we report the improved MRFM that we developed. This device is temperature variable from room temperature to low temperature, compared with the device that we reported, and has a structure that is easy to exchange samples. In the case of MRFM, the experiment is carried out in a cryogenic environment as possible in order to improve the sensitivity. However, due to low temperature environment, sample replacement and preparation process is very time consuming and our apparatus is a device with relatively easy sample exchange. Basically, the optical interferometer and the field gradient magnet are fixed on a three-axis nano-stage that can move in x, y and z directions.

References:
[1] J. A. Sidles, Appl. Phys. Lett. **58**, 2854 (1991).
[2] D. Rugar, C. S. Yannoni, and J. A. Sidles, Nature **360**, 563 (1992).
[3] S. Won et al., Sci. Rep. **3**, 3189 (2013).