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Force-Induced remnant magnetization spectroscopy for magnetic sensing with molecular specificity

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Molecule-specific noncovalent bonds are the foundation for many key processes in the life sciences and medical diagnostics, such as DNA replication, enzyme catalysis, and cellular uptake. Magnetic labeling with nanoparticles and optical labeling with fluorescent dyes are major avenues to probe the molecules involved in noncovalent bonds. Compared to optical sensing which uses a wavelength parameter to achieve molecular and cellular specificity, magnetic detection has no analogous parameter. To solve this problem, we develop a spectroscopic technique based on the binding force between the probe molecules labeled with magnetic nanoparticles and the receptor molecules on cell surface. This force-induced remnant magnetization spectroscopy (FIRMS) measures the magnetization of the magnetic nanoparticles as a function of the binding force between the magnetically-labeled probe molecules and the target molecules. Molecular specificity is achieved from the spectrum of magnetization vs. binding force. We will demonstrate this novel concept by investigating the reversible binding between biotin and streptavidin, and between biotin and avidin, using various forms of forces. Because magnetic labeling, unlike optical labeling, can be employed under opaque conditions, the addition of molecular specificity afforded by the FIRMS technique will lead to quantitative molecular and cellular imaging for diagnostics at practical settings.

Biography

Shoujun Xu obtained BS from Nanjing University (China) and PhD from Johns Hopkins University in 2002. I am current employed at the Chemistry Department of the University of Houston as an assistant professor. My expertise are in magnetic sensing, atomic magnetometry, molecular imaging, and magnetic resonance imaging.

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