Remote detection of nuclear magnetic resonance with an anisotropic magnetoresistive sensor

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Abstract: We report the detection of nuclear magnetic resonance (NMR) using an anisotropic magnetoresistive (AMR) sensor. A "remotedetection" arrangement was used in which protons in flowing water were prepolarized in the field of a superconducting NMR magnet, adiabatically inverted, and subsequently detected with an AMR sensor situated downstream from the magnet and the adiabatic inverter. AMR sensing is well suited for NMR detection in microfluidic "lab-on-a-chip" applications because the sensors are small, typically on the order of 10 μm. An estimate of the sensitivity for an optimized system indicates that ≈6 × 1013 protons in a volume of 1,000 μm3, prepolarized in a 10-kG magnetic field, can be detected with a signal-to-noise ratio of 3 in a 1-Hz bandwidth. This level of sensitivity is competitive with that demonstrated by microcoils in superconducting magnets and with the projected sensitivity of microfabricated atomic magnetometers.
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