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Magnetization detecting electron paramagnetic resonance spectroscopy using a dc-SQUID directly coupled to an electron spin ensemble¹ HIRAKU TOIDA, YUICHIRO MATSUZAKI, KOSUKE KAKUYANAGI, XI-AOBO ZHU², WILLIAM MUNRO, NTT Basic Research Laboratories, KAE NEMOTO, National Institute of Informatics, HIROSHI YAMAGUCHI, SHIRO SAITO, NTT Basic Research Laboratories — Electron parametric resonance (EPR) spectroscopy is one of the most widely-used tool to characterize materials containing unpaired electrons. In the case of conventional EPR spectrometers, the resonance is detected as a change of microwave transmittance of a cavity. In our method, on the other hand, magnetization of the sample induced by the resonance is detected by a direct current superconducting quantum interference device (dc-SQUID) magnetometer, which is bonded to the sample. Here, we report detection of electron spin polarization and EPR spectroscopy using a micrometer-sized dc-SQUID magnetometer. We measure temperature and in-plane magnetic field dependence of spin polarization ratio and it has good agreement to the hyperbolic tangent law. We also successfully demonstrate EPR spectroscopy by applying a continuous microwave signal to the sample with a on-chip microstrip. We estimate the sensing volume and the minimum distinguishable number of electron spins to be $\sim 10^{-10}$ cm³ (~ 0.1 pl) and $\sim 10^6$, respectively. This result paves the way towards realizing highly sensitive EPR spectroscopy in nanometer-sized area.

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