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Program: Advanced Materials Science and Technology

Area: Materials Science and Technology

Undergraduate: Dept. of Engineering

Professional Expertise

We have been doing nuclear magnetic resonance (NMR) study on two topics. One is an attempt to realize quantum computation and the other is quantum physics in various materials. In the field of quantum computation, it is well known that nuclear spin is one of the best quantum bits (qubits) because of the extremely longer coherence time (T_2) than the other qubits. Moreover, it is getting clear that some puzzling phenomena can be understood in terms of the interaction between nuclear spins and electron spins. To investigate the quantum phenomena in various materials, on the other hand, nuclear spins present you site-selective information on the electronic states due to the interaction between the nuclear spins and the electronic spins. In other words, nuclear spins play a role of microscopic probes that are “naturally built in” the material. Therefore, we would like to call the NMR study from these viewpoints as “nuclear-spintronics”, as opposed to “spintronics” named for the study on electron-spin related phenomena

Research Fields of Interest

Nuclear-Spin Behavior in Semiconductors

-An attempt to realize Solid-State Quantum Computers Using Nuclear Spins-

- Spectra of Noise in Solids
- ^{29}Si Nuclear-Spin Behaviors in bulk and fabricated silicon
- ^{69}Ga , ^{71}Ga and ^{75}As Nuclear-Spin Behaviors in bulk GaAs and quantum Hall state of AlGaAs

Quantum Spin State of New Materials

- Chain-Driven Superconductivity in $\text{Pr}_2\text{Ba}_4\text{Cu}_7\text{O}_x$



Education and Career

2000-1989: Researcher at NTT Basic Research Laboratories, Japan

(1996: Ph.D. in Physics, Graduate School of Science, University of Tokyo, Japan)

1989: Master Degree in Physics, Graduate School of Science, University of Tokyo, Japan

1987: Bachelor Degree in Department of Physics, Waseda University, Japan

Professional Societies and Activities

Member of The Physical Society of Japan

Major Publications

Papers

[1] "Measurement of the Noise Spectrum Using a Multiple-Pulse Sequence," Tatsuro Yuge, Susumu Sasaki, Yoshiro Hirayama; Phys. Rev. Lett. 107, 170504 (2011).

[2] "Observation of Strains Caused by Heterostructure Interfaces," M. Nishimori, H. Hasegawa, S. Sasaki, S. Watanabe, Y. Hirayama; Physica Status Solidi C8, 399 (2011).

[3] "Direct observation of local magnetic field generated by micromagnet"; Shinji Watanabe, Susumu Sasaki, Shinya Sato, Naoki Isogai and Yoshinori Matsumoto; Appl. Phys. Lett. 92, 253116 (2008).

[4] "Dynamical suppression of nuclear-spin decoherence time in Si and GaAs using inversion pulses"; S. Watanabe, J. Harada, S. Sasaki, Y. Hirayama; J. Magn. Magn. Matter. 310, 2167 (2007).

[5] ²⁹Si Nuclear-spin decoherence process directly observed by multiple spin-echoes for pure and carrier-less silicon; Shinji Watanabe, Susumu Sasaki; Jpn. J. Appl. Phys. 42, L1350 (2003).