

高周波電場による回転系断熱消磁の研究

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Adiabatic demagnetization in the rotating frame by use of the rf electric field

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03640346

Research Category

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Allocation Type

Single-year Grants

Research Field

物理学一般

Research Institution

KANAZAWA UNIVERSITY

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Nuclear magnetic resonance / NMR / Adiabatic demagnetization in the rotating frame / ADRF / rf electric field

Research Abstract

In the preceding year, we examined the possibility of the adiabatic demagnetization in the rotating frame (ADRF) due to an rf electric field, and observed a large irreversibility. The experiment was carried out in a double quantum ($\Delta m = 2$) transition of the ^{27}Al nuclear spin system in Al_2O_3 single crystal at room temperature by means of frequency-sweep. The rf electric field induces the time-dependent electric quadrupole interaction. In this year, we have clarified the cause of the large irreversibility as shown below, and verified that the ADRF is realized in principle by the rf electric field.


A large irreversibility is also observed by use of a double quantum resonant rf magnetic field in this spin system, the degree of which is the same as that of the ADRF due to the rf electric field under the experimental condition which is essentially the same. The irreversibility of the ADRF in the single quantum transition is lower than that in the double quantum transition. On the other hand, in a two-level system such as that of the ^{19}F spin system in CaF_2 , the ADRF is highly reversible as well known. From these results, we can conclude that the large irreversibility is not inherent in the rf electric field excitation but due to the characteristics of the multilevel system of the ^{27}Al spin system. This irreversibility is produced by the thermal mixing which is caused between the Zeeman and dipolar systems under the large temperature difference when the frequency reaches the edge of the line, and therefore, appears in the ADRF in any spin system. However, the degree of the irreversibility depends on the product of the Larmor frequency due to the local field and the free


decay time. The large irreversibility is due to the large product. Once the temperature difference becomes small, the ADRF proceeds with a high reversibility afterward.

Research Products (2 results)

All Other

All Publications (2 results)

[Publications] 畠中 洋志,高濱 正寛: "Adiabatic demagnetization of quadrupolar nuclear spins in a rotating frame by use of an rf electric field" Physical Review B. 47. 3213-3219 (1993) 

[Publications] Hiroshi Hatanaka and Masahiro Takahama: "Adiabatic demagnetization of quadrupolar nuclear spins in a rotating frame by use of an rf electric field" Physical Review B. Vol.47. 3213-3219 (1993) 

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