Applied Magnetic Resonance (2023) 54:435–437
https://doi.org/10.1007/s00723-023-01543-w

Applied
Magnetic Resonance

EDITORIAL

Trends in Magnetism

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Published online: 17 April 2023

The magnetic resonance method is actively used to determine the ground state of magnetic systems, which depends on the symmetry of the immediate environment. Taking into account the crystal field and exchange bonds, the values of hyperfine fields and the parameters of the quadrupole interaction can be determined theoretically and compared with the values experimentally determined based on the analysis of magnetic resonance spectra. This is clearly shown for chromium and niobium ions in Cr_xNbSe_2 from DFT calculations and NMR experiments by Polina Agzamova and Vasily Ogloblichev in the article "Electronic Structure and Hyperfine Interactions in Cr_xNbSe_2 ($x=0.33$, 0.5) by DFT studies".

Magnetometry methods are integral and do not allow the unambiguous identification and analysis of contributions from various phases under conditions of the phase separation in a sample. The magnetic resonance method has all the advantages in this case, since the magnetic phase separation in a sample leads to the observation of new lines in the magnetic resonance spectrum, the interpretation of which makes it possible to reveal the magnetic features of the emerging phases. The features of the phase separation and the observation of a Griffiths phase are demonstrated in the article "Magnetic Properties of $La_{0.81}Sr_{0.19}Mn_{0.9}Fe_{0.1-x}Zn_xO_3$ ($x=0$, $x=0.05$)" by Z. Y. Seidov et al.

The pulse methods of various sequences are applied to measure the spin–spin and spin–lattice relaxation times. Using the Carr–Purcell–Meiboom–Gill (CPMG) pulse sequence, I. Khairutdinov et al. show experimentally and theoretically in their paper "Tuning Effective Relaxation Time in CPMG Sequence by Varying the Rotation Angle of the Refocusing Pulses" that the application of refocusing

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pulses with a rotation angle of 90° or less increases the effective relaxation time. This elongation is due to the fact that at inefficient spin angles, the longitudinal components of the magnetization begin to contribute to the observed signal. The lifetime of these components is determined by the spin–lattice relaxation, which is usually much longer than the spin–spin relaxation time. As a result, the lifetime of the echo signal increases.

To create quantum computers, it is necessary to increase the spin relaxation time for impurity ions in dielectric crystals; therefore, the search for objects with long spin–spin and spin–lattice relaxation times is very important. Relaxation times of about 40 μs are obtained for the vanadium isotope in an isotopically pure crystal over a temperature range from 4 up to 10 K in the article "Hyperfine Effects and Electron Spin Relaxation of $^{51}V^{4+}$ Doped into Scandium Orthosilicate $Sc_2{}^{28}SiO_5$: CW and Pulsed X-Band Electron Spin Resonance Studies" by R. F. Likerov et al.

The most diverse types of magnetic order can be observed in low-dimensional magnets. The application of the magnetic resonance method provides an invaluable opportunity to unravel the ground state of magnetic systems. The analysis of resonance spectra from an antiferromagnetic or ferromagnetic system makes it possible to obtain data on the magnetic field of anisotropy and the exchange field as demonstrated for $Cu_2(OH)_3Cl$ in the article " High-Field Magnetization and ESR Studies of Two-Dimensional Triangular-Lattice Antiferromagnet $Cu_2(OH)_3Cl$" by Tongtong Xiao et al.

The analysis of the structure and exchange bonds makes it possible to calculate the spectra of antiferromagnetic resonance in the article "Spin Wave Spectra in Pseudoperovskite Manganites with Superexchange Interaction Competition" by Liudmila E. Gonchar.

The response dynamics of the total magnetic moment of two antiferromagnetically ordered nanoparticles coupled by the dipole–dipole interaction and differing in the uniaxial anisotropy value on a short Gaussian pulse of magnetic field is studied by A. Shutyi, S. Eliseeva and D. Sementsov in the article "Pulsed Magnetization Reversal Two Dipole-Coupled Nanoparticles with Antiferromagnetic Ordering".

The magnetic resonance method is extremely useful in the study of magnetic semiconductors, where it enables to separate contributions from the impurity ions, conduction electrons, and the ordered phase. The ESR technique was used by Y. Talanov et al. in the article " Features of $EuFe_2As_2$ Magnetic Structure Revealed by ESR" for studying ordered and paramagnetic states in $EuFe_2As_2$ and by Serdar Gökçe et al. in the article "Magnetic ordering in $TlGa_{1-x}Fe_xSe_2$ dilute magnetic semiconductors with various Fe dilution ratios" for interpreting the symmetry of the impurity paramagnetic center.

In the paramagnetic region, when approaching the phase transition temperature, the regions of short range order lead to a broadening of the magnetic resonance line and a deviation of the resonance magnetic field**.** The theoretical description of the ESR linewidth temperature dependence makes it possible to estimate the degree of dimensionality of the magnetic interactions as a quasi-one-dimensional, two-dimensional, or three-dimensional system. This case is demonstrated in the article "Magnetic Phase Separation in Double Perovskite $Sr_2TiMnO_{5.87}$" by D.V. Popov et al.

Technical aspects of a new type of resonator were described by Morteza Vafadar Yengejeh and Bulat Rameev in the article “Through-hole Microwave Resonators for Magnonic Quantum Transducer”.

We are most appreciative of Prof. Kev M. Salikhov, Editor-in-Chief, who gave us an opportunity to present recent progress in advanced magnetic resonance techniques to study the magnetic ground state of magnetics in this special issue of *Applied Magnetic Resonance*. We are grateful to Dr. Laila Mosina, Assistant Editor, for helpful comments.

We would like to thank most heartily all contributors to this special issue.

Data availability This article is publicly available and has been prepared for publication in the Applied Magnetic Resonance journal.