ORDERED PHASE OF NUCLEAR SPINS IN UNIAXIAL FERROMAGNETIC FILMS AT ULTRALOW SPIN TEMPERATURES

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9.7 cm

Nuclear spin system behavior in uniaxial ferromagnets at ultralow spin temperatures is theoretically investigated. In the given case spin ordering is caused by the Suhl-Nakamura indirect interaction consisting of hyperfine interaction joined with exchange interaction between electron spins. Unlike to the ordinary approach the demagnetization effects are taken into account. As a result the modified Hamiltonian including dipole-dipole interaction between electron spins is written down. Thereby ordered states of nuclear spins are studied applying mean field approach. It is shown that the ordered state of nuclear spins can be established only in film specimens where static magnetic field is perpendicular to the film plane. Then ferromagnetic ordering of nuclear spins takes place and ordering direction is generally nonparallel to the static magnetic field (in case of full compensation of hyperfine field on nuclei by the static magnetic field the ordering direction lies in the film plane). The ordering temperature and spectrum of linear nuclear spin excitations in the mentioned state is also calculated. It is noted that ultralow spin temperatures can be reached experimentally using dynamical polarization and adiabatic demagnetization methods.

13.4 cm

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