ESR study of the conductive dicyano Fe-Phthalocyanine compound TPP[Fe(Pc)(CN)$_2$]$_2$

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Interplay between various degrees of freedom in solid (e.g., charge, spin, lattice etc…) is one of the most attractive issues of present condensed matter physics. Giant magnetoresistance (MR) is a typical phenomenon, which comes from the coupling between magnetism (spin) and conductivity (charge). The conductive dicyano Fe-Phthalocyanine ([Fe(Pc)(CN)$_2$]) compound TPP[Fe(Pc)(CN)$_2$]$_2$ is a one-dimensional (1D) magnetic organic semiconductor, which shows large negative MR at low temperatures. In spite of the intensive studies of this material [1,2], the origin of the negative MR has not been fully understood yet. Our recent MR and magnetic torque studies show that the negative MR is associated with some magnetic-field-induced transition [3]. However, the discussion of the MR mechanism remains insufficient because of the lack of the detailed information of the magnetic state. In order to obtain the microscopic information of the magnetic ground state, we have performed electron spin resonance (ESR) measurements.

The ESR signals are observed below 15 K, and the signal intensities monotonically increase toward the lowest temperature (0.6 K). This behavior is consistent with the magnetic susceptibility measurements [2]. The analysis of the angular dependence of the *g*-values shows that a single ESR signal originates from the individual 1D Fe(Pc)(CN)$_2$ chain in the crystal, and no long-range magnetic order is formed down to 0.6 K. The observed *g*-values (e.g., g~1.07 along the largest principal axis) are quite different from those of the isolated Fe(Pc)(CN)$_2$ molecule. This means that the Fe moments are not isolated but strongly coupled with the π spins and/or other Fe moments in each chain. We will report the detailed results of the ESR measurements, and discuss the relationship between the anisotropy of the *g*-value and the MR effect.

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