Research Group Magneto-Optical and THz Spectroscopy would like to invite you to the seminar:

CEITEC
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Weak exchange coupling detection at room temperature via EPR

DELIVERED BY

Dr. Vinicius Tadeu Santana

CEITEC Brno University of Technology, Magneto-Optical and THz Spectroscopy

ABSTRACT

Molecular compounds with one or more coordinated metal ions per molecule may be connected by covalent or non-covalent paths to their neighbours. These so-called coordination polymers are relevant to several fields such as molecular magnetism, catalysis, biochemistry, and others. Besides, they may display interesting phenomena such as quantum phase transitions. We report electron paramagnetic resonance (EPR) studies at Q and X-bands of powder and oriented single crystal samples of the compound [Cu(N',N'-dimethyl-N'-benzoylthiourea)(2,2'-bipyridine)Cl], called CuBMB.[1] EPR spectra of single crystal samples at Q-band and room temperature display abrupt mergings and narrowing of the peaks arising from two rotated copper sites with the orientation of an external magnetic field B0.
Weak intermolecular exchange interactions |Ji| between neighbour copper spins, responsible for the exchange narrowing processes produce a quantum transition from an array of quasi-isolated spins to a quantum-entangled spin array.
This transition occurs when the magnitudes of the anisotropic contributions to the Zeeman couplings, tuned with the direction of B0, approach these |Ji| and produce level crossings.
We pinpoint the excellent capability of EPR in this kind of studies, where weak exchange coupling magnitudes would require temperatures in the range of 10-3 K to be detected via thermodynamic techniques such magnetic susceptibility measurements.
The effect of an entagled phase in the EPR spectrum directly affects the properties of an absorption profile via the modulation of the linewidth by the exchange narrowing phenomenon even at room temperature. Besides, we indicate specific features in the powder spectra that point to the presence of an entangled phase. A similar approach can be followed for any system where either inter or intra molecular exchange coupling causes the collapse of the EPR spectra around transition crossings.
In conclusion, it is clear that molecules can be engineered to behave according to the expected phase depending on the application and we intend to further investigate this phenomenon at higher frequencies and magnetic fields for a wider range of materials and spin-spin interaction magnitudes.

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