

Spin transitions of $Fe^{II}(phen)_2(NCS)_2$ in ethylene glycol matrix

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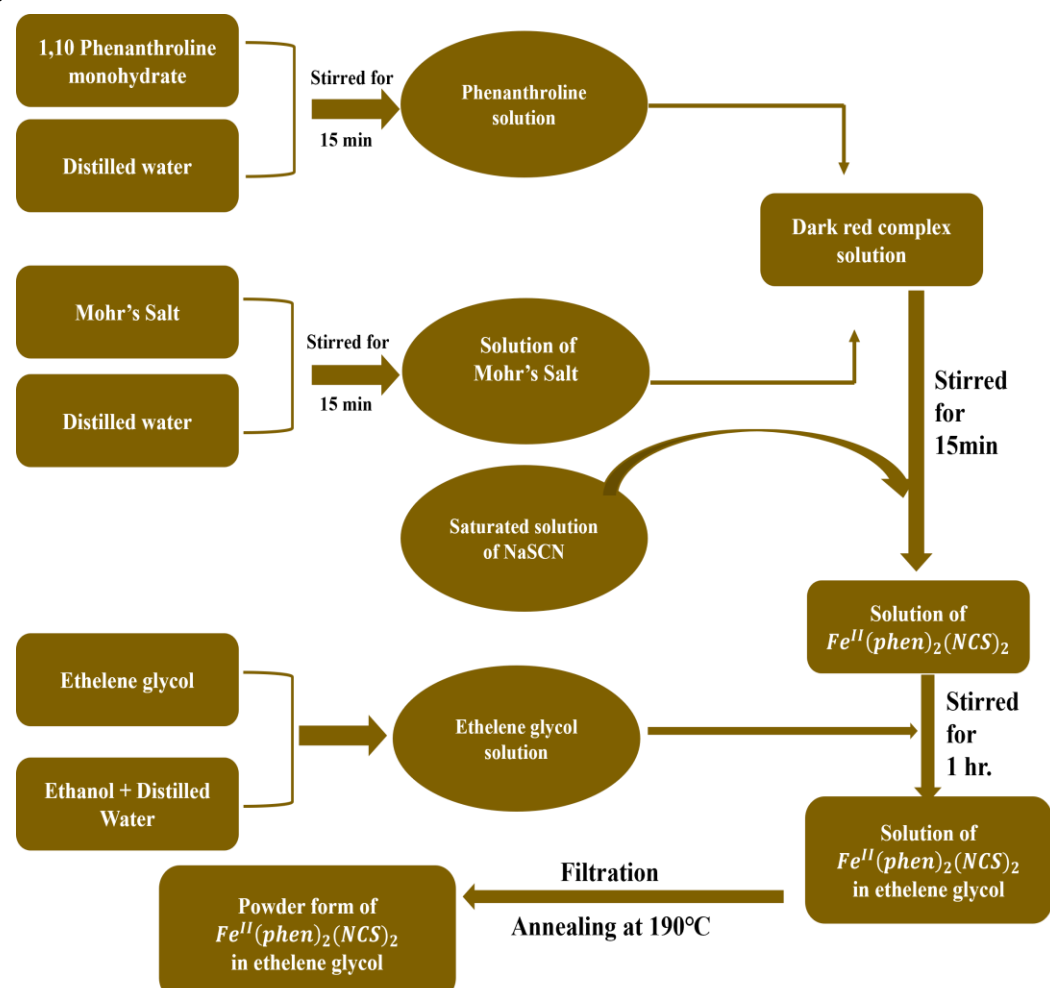
INTRODUCTION

- Spin crossover materials are able to switch between high spin (HS) and low spin (LS) states in response to different external stimuli, such as pressure, temperature, light, electric and magnetic fields.
- The alteration in spin states significantly affects the material's physical properties including color, magnetic moment, dielectric constant, electrical conductivity, and thermal conductivity.
- These materials have potential applications in switches, displays, memory devices, electrical and electroluminescent devices, as well as in hybrid electronics and optoelectronics.

OBJECTIVES

- To investigate spin transitions of $Fe(II)$ based spin crossover (SCO) complex $Fe^{II}(phen)_2(NCS)_2$ which shows spin state bi-stability between its high spin (HS, $S=2$) and low spin (LS, $S=0$) embedded in ethylene glycol matrix.
- To probe the effect of glycol matrix on the spin transition of SCO complex through structural, electrical and magnetic measurements.

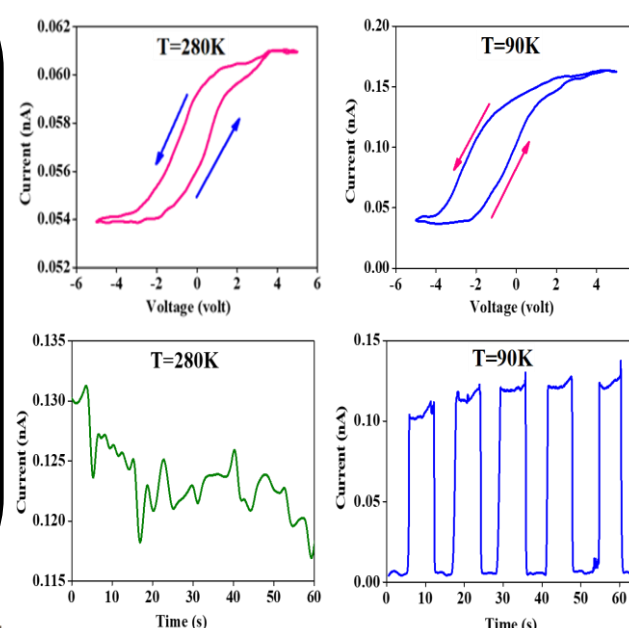
METHOD



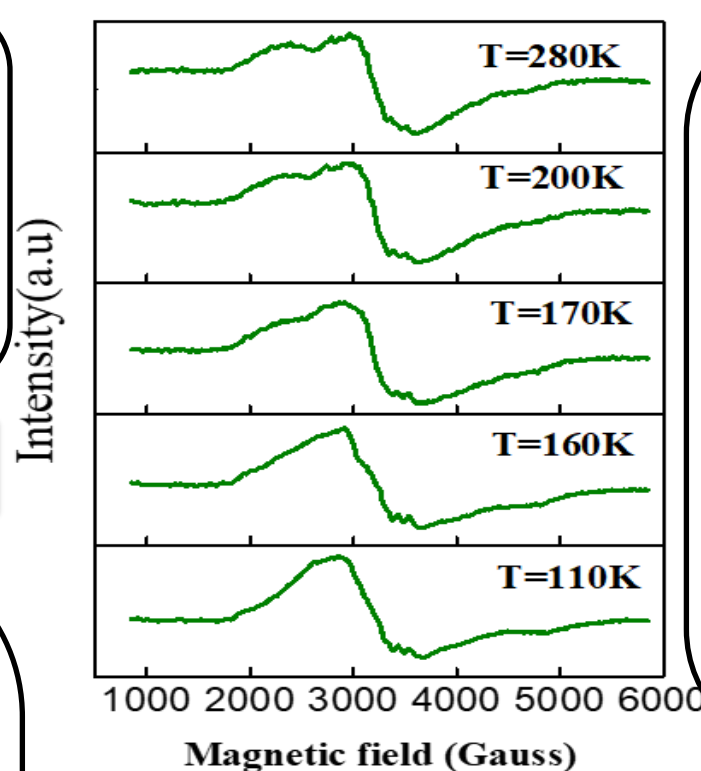
RESULTS & DISCUSSION

- The XRD patterns confirm the series of distinct sharp reflections characteristic to $Fe^{II}(phen)_2(NCS)_2$ in ethylene glycol matrix.
- The XRD pattern of SCO complex consist of peaks with that of bulk data but with a slight difference in peak positions possibly arising out of lattice strain.

RESULTS & DISCUSSION



- Temperature dependent I-V data shows thermal spin-state switching with prominent hysteresis loop.
- At low temperature ($T=90$ K) the complex exhibits LS state with higher conductivity.
- At high temperature ($T=280$ K) it shows lower conductivity in HS state.
- The measured I-t data under dark and illumination at 300 K and 90 K respectively provides a better photo-induced response at lower temperature.



- Spin transitions are also further probed by electron paramagnetic resonance (EPR) in the temperature range 110-280 K.
- The EPR data at 280 K shows a broad signal at 3000 Gauss gives $g=2.1$ along with an additional peak at 2300 Gauss corresponding $g=2.9$.
- The additional peak is smeared out as the temperature is reduced below 170 K which can be ascribed to HS to LS spin transition.

CONCLUSION

- The SCO material $Fe^{II}(phen)_2(NCS)_2$ in ethylene glycol matrix is synthesized using wet chemical method.
- We report here the structural, electrical and magnetic properties of the SCO compound.
- The X-ray diffraction (XRD) study reveals the slight difference in peak position with that of bulk data which is possibly due to effect of strain.
- A clear hysteresis loop is exhibited in the electrical conductivity data indicating LS-HS transition.
- The I-t data gives a better photo-induced response at low temperature.
- The EPR study show that the transition temperature comes out to be <170 K which is slightly lower than that of bulk 176 K.
- It also suggests a modified spin interactions of the spin crossover complex embedded in ethylene glycol matrix which may be important to fabricate spin based devices in future.

REFERENCES

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- Cantin, C., Daubric, H., Kliava, J., Servant, Y., Sommer, L., & Kahn, O. (1998). *Journal of Physics: Condensed Matter*, 10(31), 7057.

