Muon Spin Spectroscopy of Discotic Liquid Crystals

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Disk-shaped molecules can self assemble into columns that provide a low-dimensional conduction pathway due to the overlap of π-systems on neighbouring molecules [1]. The unique structural and electronic properties of discotic liquid crystals could be used in many applications including molecular electronics. Labeling discotic liquid crystals with spin polarized positive muons can be used to study molecular dynamics and the interactions between adjacent molecules. The Mu adducts of two discotic liquid crystals, hexahexylthiotriphenylene (HHTT) and hexaalkoxytriphenylene (HAT6), have been characterized using avoided level crossing muon spin resonance (ALC-μSR) and longitudinal field muon spin relaxation (LF-μSR). HHTT and HAT6 are unusual in that narrow resonances are observed in the crystalline phase while a very broad resonance is observed in the mesophase and isotropic phase. The broad resonance arises from increased electron spin relaxation at high temperature, which is caused by electron hopping along the columns of HHTT or HAT6 molecules.

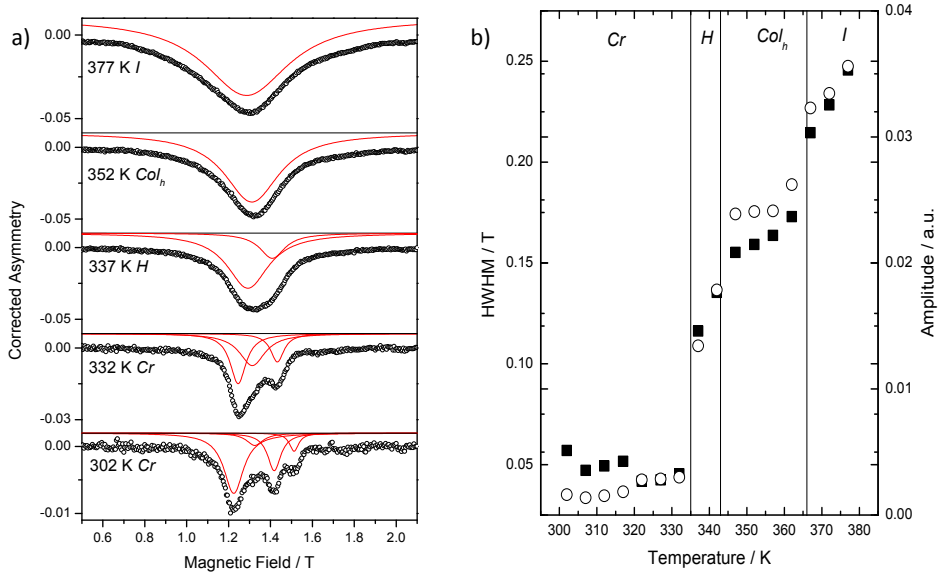

Fig. 1: a) ALC-μSR spectra of the Mu adduct of HHTT as a function of temperature. b) Temperature dependence of the width and amplitude of the Δ_1 resonance in HHTT.

[1] S. Laschat et al., Angew. Chem. Int. Ed. 46 (2007) 4832.