Experimental report

14/02/2018

Proposal: 6-07-20 **Council:** 10/2016

Title: Inelastic fixed window scans on a nanoconfined discotic liquid crystal

Research area: Soft condensed matter

This proposal is a resubmission of 6-07-11

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Samples: C54_H84_O6
nanoporous Al2O3

Instrument	Requested days	Allocated days	From	To
IN16B	4	3	19/12/2016	22/12/2016

Abstract:

Discotic liquid crystals (DLC) are soft-matter materials which organize into columns that further assemble into two-dimensional arrays with a hexagonal mesophase. Highly ordered columnar structures were found to be very promising as active semiconductors in organic field-effect transistors and photovoltaic devices. The charge transport in these systems is controlled by their molecular mobility. Confining DLCs to the unidirectional channels of nanoporous anodic aluminium (AAO) can be regarded as model system for nanoscaled wires. To get an overview about the molecular mobility of a triphenylene based DLC in the bulk and confined to the 80 nm and 40 nm wide pores of AAO it is proposed to carry out inelastic fixed window scans on a backscattering instrument.

EXPERIMENTAL REPORT

EXPERIMENT N°6-07-20 INSTRUMENT IN16B

DATES OF EXPERIMENT 19/12/2016-22/12/2016

TITLE

Inelastic fixed window scans on a nanoconfined discotic liquid crystal

EXPERIMENTAL TEAM

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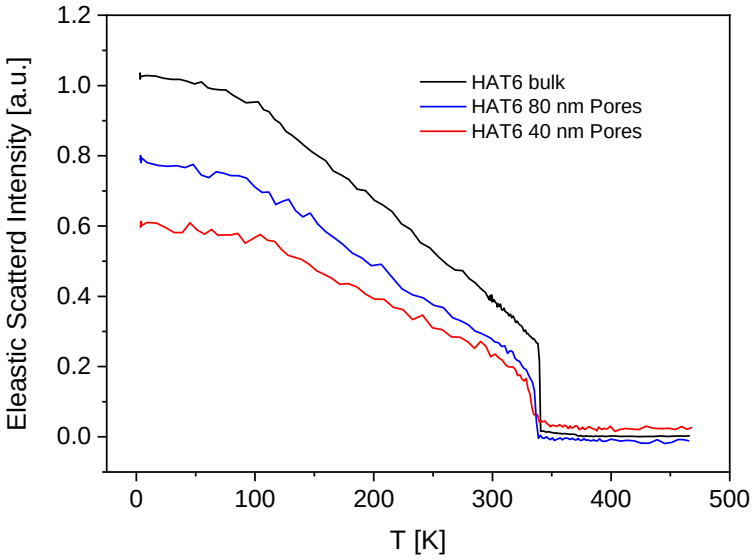
Date of report 30/08/2017

Discotic liquid crystals (DLC) are self-assembled materials where self-assembly is driven by noncovalent intermolecular interactions [1]. DLCs consist of a flat and rigid aromatic core substituted by flexible aliphatic side chains. The former is responsible for the π-stacking and the latter for the increased solubility, processability, and rich thermotropic behavior. The disc-shaped molecules organize into columns that further assemble into two-dimensional arrays with a hexagonal mesophase. The alkyl chains fill the intercolumnar space giving rise to a nanophase separated state.

To have an overview about the influence of a nanoscale confinement on the molecular incoherent neutron scattering experiments are carried out at IN16B for bulk Hexakis [n-hexaoxy]triphenylene (HAT6) embedded to the pores of commercial available anodic aluminum membranes (AAO) (Smart Membranes, Pore diameter 25nm, 40nm, 80 nm). For preparation the empty aluminium membranes were treated in vacuum to remove impurities and after that transferred in vacuum into a glove box filled with Argon. The pores were filled by melting the DCL on the top of the membrane at a temperature above the clearing temperature by capillary wetting. The filling degree was estimated by TGA measurements. The experiments were done on IN16B (λ=6.271 Å). We carried out fixed window scans cycling between EFWS (E=0) and a fixed offset energy (ΔE=2μeV). For the confined liquid two orientations were measured to check for anisotropy of the dynamics. In one orientation the sample was placed with the pores parallel to the Q vector at 90° scattering angle, for the other perpendicular. All spectra were corrected for the scattering of the empty host membrane sealed under Argon and the empty can.

Figure 1 shows the elastically scattered intensity versus temperature for bulk HAT6 and confined to pores with diametrs of 80 and 40 nm. The scattered intensity and the phase transition show a dependence of pore size. This is currently anaysed in deeper detail.



Elstically scattered intensity for the indicated samples at an angle of ca. 90 degree.