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Near-edge X-ray absorption fine-structure spectroscopy of naphthalene diimide-thiophene co-polymers

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Near-edge X-ray absorption fine-structure (NEXAFS) spectroscopy is an important tool for probing the structure of conjugated polymer films used in organic electronic devices. High-performance conjugated polymers are often donor-acceptor co-polymers which feature a repeat unit with multiple functional groups. To facilitate better application of NEXAFS spectroscopy to the study of such materials, improved understanding of the observed NEXAFS spectral features is required. In order to examine how the NEXAFS spectrum of a donor-acceptor co-polymer relates to the properties of the sub-units, a series of naphthalene diimide-thiophene-based co-polymers have been studied where the nature and length of the donor co-monomer has been systematically varied. The spectra of these materials are compared with that of a thiophene homopolymer and naphthalene diimide monomer enabling peak assignment and the influence of inter-unit electronic coupling to be assessed. We find that while it is possible to attribute peaks within the π^* manifold as arising primarily due to the naphthalene diimide or thiophene sub-units, very similar dichroism of these peaks is observed indicating that it may not be possible to separately probe the molecular orientation of the separate sub-units with carbon K-edge NEXAFS spectroscopy

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Primary author: Dr THOMSEN, Lars (Australian Synchrotron)

Co-authors: MCNEILL, Chris (Monash University); GANN, Eliot (Australian Synchrotron)

Presenter: Dr THOMSEN, Lars (Australian Synchrotron)

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