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NOVEL MAGNETO-OPTIC BEHAVIOR FROM A POLYSQUARAINE: STRUCTURE / PROPERTY RELATIONSHIP

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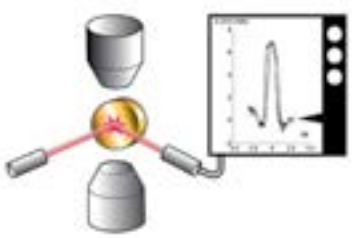
Poly((2,5-bis(1-methylpyrrol-2-yl)thiophene)squaraine) can be synthesized as a dark green insoluble powder which when subjected to shear force and pressed as a disk exhibits a gold-green near optical quality surface with semi-metallic behaviour. Reflectivity measurements at a wavelength of 819 nm reveal a high (72°) pseudo-Brewster angle and non-zero p-reflectivity whilst electrical measurements using a four-point probe return a conductivity of 1 x 10-5 S.cm-1. Unexpectedly the disks also exhibit magneto-optic (MO) activity which it appears must arise from a weak magnetic component intrinsic to the samples. In both the longitudinal and transverse Kerr configurations large fractional changes in reflectivity (ΔI/I ≈ 2.5x 10-2) are observed across a wide range of angles of incidence for wavelengths between 400 nm and 1064 nm on application and reversal of a magnetic field. Anomalously for these configurations all the MO effects observed are quadratic in the applied field and no first-order effects linear in applied field are observed for any state of incident polarisation. Examined using conventional magnetometry disk samples return saturation magnetization values of 4.13 x 10-3 emu.g-1 on a vibrating sample magnetometer and smaller samples similarly processed and prepared for examination by Squid magnetometer confirmatory values of 4.9 x10-3 emu.g-1. Magnetization curves from both instruments have a similar form saturating at about 1.14 kOe and are also in close correspondence with curves derived by plotting the magneto-optic signal as a function of field. Similarly both the magnetic and magneto-optic behaviour of all samples is isotropic in plane.All experimental observations on this polymer appear to be commensurate with the development of some form of magnetic state throughout very limited regions of the material. A model able to reconcile the magnetic and MO observations is presented as well as a discussion of the importance of the material structure in relation to the observed phenomenon.



Recent Publications

1. **Lynch DE, Hamilton DG (2018) Microreview: Pyrrol-3-yl squaraines (including indol-3-yl squaraines). Journal of Heterocyclic Chemistry DOI: 10.1002/jhet.3173.**
2. **Lynch DE, Hamilton DG (2017) Croconaine Dyes – the Lesser Known Siblings of Squaraines. European Journal of Organic Chemistry 3897-3911.**
3. **Lynch DE, Hamilton DG (2017) The History of Azulenyl Squaraines. Australian Journal of Chemistry 70:857-871.**
4. **Lynch DE (2015) Pyrrolyl Squaraines – Fifty Golden Years. Metals 5: 1349-1370.**
5. **Lynch DE, Newman DM, Wears ML, Matelon RJ (2013) Novel magneto-optic behavior from a polysquaraine. Synthetic Metals 171:15-22.**

Biography

Daniel Lynch is a materials chemist and crystallographer with recent experience in plastics additives; BAppSc degree (1990) and PhD (1994), from QUT in Brisbane (Australia). A postdoctoral fellowship at Cranfield University (UK) preceded a six-year university research fellowship at Coventry University (UK), becoming a Senior Lecturer in 2001 and a Reader of Applied Chemistry in 2007 at the same institution. He is the author of 250 research publications, the principal inventor of Exilica's patented technology and became the full-time Technical Director of Exilica Limited in 2007, a post that he had held on a part-time basis since Exilica's incorporation in May 2005. (orcid.org/0000-0001-6210-5316).

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