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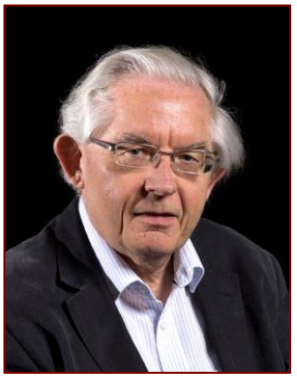

Biographical details: Howard was born in Co. Durham in 1951 and attended Washington Grammer School. After degrees at the Universities of Cambridge (MA) and London (PhD), he carried out research at the ICI Corporate Laboratory in Cheshire before moving to Manchester University in 1994 as a Royal Society Industry Fellow, and then to the Chair of Materials Chemistry at the University of Reading in 2000. He was President of the Materials Chemistry Division of the RSC from 2012 to 2015. Awards for his research include the RSC Medal and Prize for Materials Chemistry (2006), the Royal Society Leverhulme Senior Research Fellowship (2007), the Wilsmore Fellowship of the University of Melbourne (2007), the degree of Doctor of Science (ScD) of the University of Cambridge (2008), the MacroGroup UK Medal for contributions to polymer science (2012), and the Royal Society Brian Mercer Feasibility Award (2013). He retired in December 2018 and currently holds a Leverhulme Emeritus Research Fellowship.

Some Recent Publications

Elements of fractal geometry in the ^{1}H NMR spectrum of a copolymer intercalation-complex. J.S. Shaw, R. Vaiyapuri, M. P. Parker, C. A. Murray, K. J. C. Lim, C. Pan, M. Knappert, C. J. Cardin, B. W. Greenland, R. Grau-Crespo and H. M. Colquhoun. *Chem. Sci*., **2018**, *9*, 4052-4061.

Trifluoromethylation of carbonyl groups in aromatic poly(ether ketone)s: formation of strongly polar yet surface-hydrophobic poly(arylenecarbinol)s. F. Leroux, R. A. Bennett, D. F. Lewis and H. M. Colquhoun. *Macromolecules*, **2018**, *51*, 3415-3422.

Quadruple stacking of macrocyclic viologen radical-cations. C. A. Murray, Z. Zhu, C. J. Cardin, H. M. Colquhoun and B. W. Greenland. *Supramol. Chem*., **2018**, *30*, 751-757.

Mutual complexation between π−π stacked molecular tweezers. M. P. Parker, C. A. Murray, L. R. Hart, B. W. Greenland, W. Hayes, C. J. Cardin, and H. M. Colquhoun, *Cryst. Growth Des*., **2018**, *18*, 386-392.

Exchange reactions of poly(arylene ether ketone) dithioketals with aliphatic diols: formation and deprotection of poly(arylene ether ketal)s. I. Manolakis, P. Cross and H. M. Colquhoun, *Macromolecules*, **2017**, *50*, 9561-9568.

Controlled variation of monomer sequence-distribution in the synthesis of aromatic poly(ether ketone)s. K. J. C. Lim, P. Cross, P. Mills and H. M. Colquhoun, *High Performance Polymers*, **2016**, *28*, 984-992.

Molecular design of a discrete chain-folding polyimide for controlled inkjet deposition of supramolecular polymers. L. R. Hart, J. L. Harries, B. W. Greenland, H. M. Colquhoun and W. Hayes, *Polymer Chemistry*, **2015**, *6*, 7342-7352.

Mesomorphic behaviour in copoly(ester-imide)s of poly(butylene-2,6-naphthalate) (PBN). S. M. Jones, S. J. Meehan, S. W. Sankey, W. A. MacDonald and H. M. Colquhoun, *Polymer*, **2015**, *69*, 66-72.

Perylene as an electron-rich moiety in healable, complementary π–π stacked, supramolecular polymer systems. L. R. Hart, N. A. Nguyen, J. L. Harries, M. E. Mackay, H. M. Colquhoun and W. Hayes, *Polymer*, **2015**, *69*, 293-300.

Supramolecular materials for inkjet printing: self-assembling polymer networks. L.R. Hart, J.L. Harries, B.W. Greenland, H.M. Colquhoun and W. Hayes, *ACS Applied Materials and Interfaces*, **2015**, *7*, 8906-8914.

Cocrystalline copolyimides of poly(ethylene 2,6-naphthalate). S. J. Meehan, S. W. Sankey, S. M. Jones, W. A. MacDonald and H. M. Colquhoun, *ACS Macro Letters*, **2014**, *3*, 968-971.

Information-containing macromolecules. H. M. Colquhoun and J. F. Lutz, *Nature Chem*., **2014**, *6*, 455-456.

Multivalency in healable supramolecular polymers: the effect of supramolecular cross-link density on the mechanical properties and healing of noncovalent polymer networks. L. R. Hart, J. H. Hunter, N. . Nguyen, J. L. Harries, B.W. Greenland, M. E. Mackay, H. M. Colquhoun and W. Hayes, *Polym. Chem*., **2014**, *5*, 3680-3688.

Pairwise assembly of organopalladium(II) units with cyanurato(3-) and trithiocyanurato(3-) ligands: formation of chiral Pd_{12}, Pd_{10} and Pd_9 cage-molecules. C. A. Murray, C. J. Cardin, B. W. Greenland, A. Swift and H. M. Colquhoun, *Inorg. Chem*., **2013**, *52*, 10424-10430.

Molecular recognition between functionalized gold nanoparticles and healable, supramolecular polymer blends – a route to property enhancement. R. Vaiyapuri, B. W. Greenland, H. M. Colquhoun, J. M. Elliott and W. Hayes, *Polym. Chem*., **2013**, *4,* 4902-4909.

Mutual binding of polymer end-groups by complementary π-π-stacking: a molecular "Roman Handshake". B. W. Greenland, M. B. Bird, S. Burattini, R. Cramer, R.K. O'Reilly, J. P. Patterson, W. Hayes, C. J. Cardin and H. M. Colquhoun, *Chem. Commun*., **2013**, *49*, 454-456.

A Microblock Ionomer in Proton Exchange Membrane Electrolysis for the Production of High Purity Hydrogen. D. W. Smith, F. O. Oladoyinbo, W. A. Mortimore, H. M Colquhoun, M. S. Thomassen, A. Odegard, N. Guillet, E. Mayousse, T. Klicpera and W. Hayes, *Macromolecules,* **2013**, *46*, 1504-1511.

Current Research Programme

Information processing at the molecular level [1]

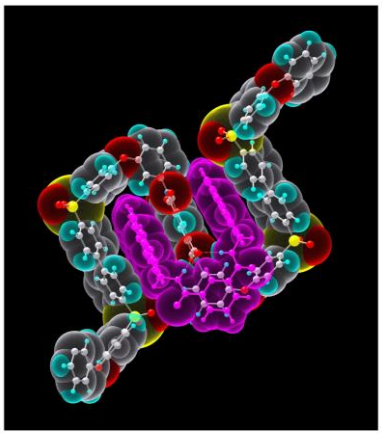

Figure 1. Computational modelling of the interaction between a tweezer-type molecule (shown in purple) and an aromatic polyimide chain

Just as the information contained in a book is embodied in a linear sequence of letters, so the information needed for all living systems to function and reproduce is embodied in a linear sequence of chemical units – monomer residues – which make up the polymer chains of DNA and RNA. The digital information coded within the nucleic acids is read and acted upon by other molecules through *the recognition of specific monomer sequences* - the biological equivalent of reading a string of binary numbers from a magnetic tape. Our recent research has shown that information-processing at the molecular scale is not restricted to biological macromolecules, but can also be achieved, in principle, with entirely synthetic polymer systems. These new systems (copolymers based on aromatic polyimides) are unrelated to the nucleic acids and are vastly more stable. Figure 1 shows a computational model in which a tweezer-type molecule (in purple) binds to a specific, sequence of nine aromatic rings linked by ether, sulfone, biphenyl, and di-imide units within a designed copolyimide chain which folds tightly around the tweezer. We have obtained strong experimental evidence for this type of binding interaction from both solution NMR and from single-crystal X-ray studies in the solid state. The binding forces involved here are mainly associated with π-π stacking interactions between the electron-rich tweezer arms and the electron-poor imide units in the polymer chain, but hydrogen bonding, identified in X-ray studies of model oligomer systems also plays a significant role. Sequence-selectivity in binding is achieved through the introduction of minor variations in the environment of the di-imide tweezer-binding site. Such selectivity has been demonstrated by ^{1}H NMR studies in which single resonances associated with specific sequences show very different responses to the presence of the tweezer-molecule. Striking changes in chemical shift are observed for "bound" sequences, but little effect is seen for more sterically-hindered sequences. Current research in this area is aimed at understanding the emergence of fractal-type NMR spectra from complexes of random-sequence binary copolyimides with aromatic probe-molecules such as pyrene and perylene.

1. (a) J. S. Shaw, R. Vaiyapuri, M. P. Parker, C. A. Murray, K. J. C. Lim, C. Pan, M. Knappert, C. J. Cardin, B. W. Greenland, R. Grau-Crespo and H. M. Colquhoun, (**2018**), Elements of fractal geometry in the ^{1}H NMR spectrum of a copolymer intercalation-complex. *Chemical Science*, *9*, 4052-4061. (b) H. M. Colquhoun and J-F. Lutz, (**2014**), Information-containing macromolecules, *Nature Chemistry*, *6*, 455-456. (c) Z. Zhu, C. J. Cardin, Y. Gan, C. A. Murray, A. J. P. White, D. J. Williams and H. M. Colquhoun, (**2011**) Conformational modulation of sequence recognition in synthetic macromolecules. *Journal of the American Chemical Society*, *133*, 19442-19447. (d) Z. Zhu, C. J. Cardin, Y. Gan and H. M. Colquhoun, (**2010**) Sequence-selective assembly of tweezer-molecules on linear templates enables frameshift-reading of sequence information. *Nature Chemistry*, *2*, 653-660.