covalent or hydrogen bonds, the crosslinks in Kornfield's gels are the result of aggregation of the end-blocks (A) due to their poor solubility in the liquid-crystal solvent. An interesting aspect is the ability of the crosslinks to reversibly open and close, allowing the polymer network to reorganize. Although this aspect introduces additional complexity into the modelling, it may be a useful feature in certain applications.

As in gelatin gels, the gelation process is thermo-reversible. This means that these materials melt to form a viscous fluid at high temperatures, but solidify again to form a gel when the temperature is lowered. But unlike gelatin gels, Kornfield's gels have the optical properties of doubly refracting crystals, and can be aligned by either magnetic or electric fields or by mechanical shear — giving evidence of the coupling of orientation and translation. The lengths of the polymer chains separating the crosslinks, as well as the crosslink density, are well defined because of the uniform degree of polymerization of the mid-blocks (B). Their unusually high molecular weight allows gels to form even at very low polymer concentrations, allowing realization of gels with a broad range of properties as the concentration is varied.

In all materials, homogeneity is a matter of length scale. Kornfield's gels are homogeneous on length scales above tenths of micrometres, rather than the tens of micrometres of more conventional polymer–liquid-crystal composites. Owing to their uniformity, and to the extraordinary length of their mid-block polymer chains, they conform very closely to theoretical rubber-elastic models that have been developed[4]. Other materials present more complex behaviour because of their less uniform and less rubber-like structure, making them less useful for fundamental studies, although they have proved fascinating for exploring potential applications.

In addition to making possible the much-needed connection between experiment and theory, Kornfield's gels can also be switched rapidly between optically clear and scattering states, and so may find use in display technology. Extensions of Kornfield's work will probably involve different liquid crystals as well as other phases. For example, investigating gels with 'banana shaped' liquid crystals[9] might be a fruitful endeavour.

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MATERIAL WITNESS

The case for talking

No one denies that emerging technologies can learn lessons from the fate of genetically modified crops in the UK. But there is no consensus about what those lessons are. Businesses might conclude that it is perilous to introduce new technologies in the face of public ignorance about their scientific basis. Opponents of global capitalism might draw faith in the power of public opinion to oppose commercial interests. The British government shows signs of concluding that sometimes the public simply does not know what is good for it.

This divergence of opinion provides one reason why the aims of the Forum for Technology, Citizens and the Market, launched in January by the Royal Society of Arts, Manufactures and Commerce (RSA) in London, are laudable. The forum will seek to encourage dialogue between industries, consumers, governmental bodies and other interested parties as emerging technologies approach the market. One of the current candidates for such treatment is nanotechnology, which some fear might go the way of GM and biotechnology in provoking a collision between public opinion and industrial intentions. Similarly, radiofrequency tagging of products (and perhaps of raw materials) promises consumer benefits, improved security and easy recycling, but carries implications for privacy and surveillance.

In this arena, 'social learning' seems to be poor among industries, scientists and the public alike. No one learns from past mistakes. Studies have suggested that opposition to GM crops was centred not on a general (mis)understanding of the science, but on the question of public trust in those making the decisions. Yet the scientific community has commonly responded by lamenting the paucity of scientific knowledge in society.

Thus scientists have tended to construct 'deficit' models to explain resistance to new technologies. Once they argued that the problem was lack of knowledge. Then they asserted that there was poor comprehension of the scientific process — how it deals with issues like uncertainty. Now that seems to be replaced by the perception of a deficit in trust of scientific authorities. In each case, the argument goes, if only the deficit were redressed, the public would welcome the technology with open arms.

This is not to deny the importance of good science communication and education. But it is patronizing to public opinion, which may draw on non-scientific (and possibly quite valid) reasons to oppose a new technology.

The challenge for projects like the RSA's is that if the hard questions about public involvement in shaping the technological future are squarely faced, they become dauntingly broad. For example, it's often argued that a misguided rejection of new technologies stifles wealth creation. But when studies show that above a certain threshold of prosperity, economic growth no longer improves social happiness, the case for wealth creation as an end in itself is no longer self-evident. Better, perhaps, to ground advocacy in terms of demonstrable social benefits — for example, for health or the environment — which will be case-specific. Harder still is the issue of whether there should be a public mandate at all for new technologies, and if so, how it should be identified.

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