MATERIAL WITNESS

Prams lead the way

It is surely ironic that global warming and environmental degradation now pose serious risks at a time when industry and technology are cleaner than at any other stage of the Industrial Revolution. Admittedly, that may not be globally true, but in principle we can manufacture products and generate energy more efficiently and with less pollution than ever before. So why the problem?

Partly, the answer is obvious: cleaner technologies struggle to keep pace with increased industrial activity as populations and economies grow. And green methodologies are typically costly, so aren't universally available. But the equation is still more complex than that. For example, cars can be more fuel-efficient and less polluting and yet cheaper. But consumers who save money on fuel tend to spend it elsewhere: they drive more, say, or they spend it on holiday air flights. And cheap cars mean more cars. There is an 'environmental rebound effect' to such savings, counteracting the gains.

This is just one way in which 'green' manufacturing — using fewer materials and environmentally friendly processing, recycling wastes, and making products themselves recyclable or biodegradable — may fall short of its goal of making the world cleaner. All of these things are surely valuable, indeed essential, in making economic growth sustainable. But the problem goes beyond how things are made, to the issue of how they are used. We need to look not just at production, but at consumption.

One of the initiatives here is the so-called Product-Service System (PSS): a combination of product design and manufacture with the supply of related consumer services that has the potential to give consumers greater utility while reducing the ecological footprint (see http://www.pre.nl/pss/download_PSSreport.htm). That might sound like marketing jargon, but it's a tangible concept of proven value, enacted for example in formalized car-sharing schemes, leasing of temporary furnished office space, biological pest-management services, and polystyrene recycling. It's not mere philanthropy either: there's a profit incentive too.

One of the key benefits of a PSS approach is that it might offer a way of simply making less stuff. You don't need to be an eco-warrior to be shocked at the senseless excesses of current manufacturing. A splendid example of an alternative model is offered by a team in Sweden, who have outlined plans for a baby-pram leasing and remanufacturing scheme (O. Mont *et al.*, *J. Cleaner Prod.* **14,** 1509–1518; 2006). As baby prams generally last for much longer than they are needed (per child), why not lease one instead of buying it? If the infrastructure exists for repairing minor wear and tear, every customer gets an 'as new' product, and no prams end up on the waste tip in a near-pristine state.

Developing countries are often adept at informal schemes like this already: little gets thrown away there. But if implemented all the way from the product-design stage, it is much more than recycling. What remains is to break our current cult of 'product ownership'. Prams seem as good a place to start as any.

Philip Ball

MOLECULAR ELECTRONICS

A sludge-to-diamond story

Unearthed after millions of years, diamondoid molecules are being studied for their possible use in single-molecule transistors, for field-emission displays and for their downright fascinating electronic properties.

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Hard to believe, but researchers have recently taken crude oil and extracted an unusual type of hydrocarbon molecule, a diamondoid, which they placed on a gold surface under the most pristine conditions on earth. Diamondoids are diamond nanocrystals with hydrogen-passivated surfaces[1,2]. The smallest in this class of hydrocarbons is adamantine, $C_{10}H_{16}$, with the carbon atoms forming a single diamond 'cage'. Diamantane ($C_{14}H_{20}$) has two cages and triamantane ($C_{18}H_{24}$) has three. These molecules and their heavier siblings have attracted much interest because of their unusual stability, electronic properties, and potential for use in nanodevices. For example, a nanotransistor has been made by placing a single C_{60} molecule between two electrodes (source and drain) with a nearby gate electrode[3] — having a new family of diamondoid molecules increases the choices of bandgaps and other electronic properties for these devices. However, the electronic structure of single diamondoid molecules has so far hardly been explored, particularly when they are in contact with metallic electrodes as they need to be for electronic devices. Wang *et al.* report on page 38 of this issue the first detailed investigation of the electronic structure of a diamondoid molecule — tetramantane, $C_{22}H_{28}$, in this case (Fig. 1) — and its spatial correlation with the lattice vibrations[4], by using a scanning tunnelling microscope (STM)[5], arguably the most delicate yet powerful instrument available for this task. In particular, they have found unexpected spatial correlations between the electronic