Cell a million?

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SOLAR cells were once a bespoke product, reserved for satellites and military use. In 1977 a watt of solar generating capacity cost $77. That has now come down to about 80 cents, and solar power is beginning to compete with the more expensive sort of conventionally generated electricity. If the price came down further, though, solar might really hit the big time—and that is the hope of Henry Snaith, of Oxford University, and his colleagues. As he described recently in *Science*, Dr Snaith plans to replace silicon, the material used to make most solar cells, with a substance called a perovskite. This, he believes, could cut the cost of a watt of solar generating capacity by three-quarters.

When light falls on a solar cell, it knocks electrons away from the cell's material and leaves behind empty spaces called holes. Electrons and holes then flow in opposite directions and the result is an electric current.

The more electrons and holes there are, and the faster they flow, the bigger the current will be. Electrons, however, often get captured by holes while still inside the cell, and cannot therefore contribute to the current. The average distance an electron travels in a material before it gets captured is known as that material's diffusion length. The larger the diffusion length, the more efficient the cell.

The silicon used in commercial solar cells has a diffusion length of ten nanometres (billionth of a metre), which is not much. Partly for this reason a silicon cell's efficiency at converting incident light into electricity is less than 10%. Dr Snaith's perovskite does better. It has a diffusion length of 1,000 nanometres, giving it an efficiency of 15%. And this, Dr Snaith says, has been achieved without much tweaking of the material. The implication is that it could be made more efficient still.

Perovskites are substances composed of what are known as cubo-octahedral crystals—in other words, cubes with the corners cut off. They thus have six octagonal faces and eight triangular ones. Perovskite itself is a natually occuring mineral, calcium titanium oxide, but lots of other elemental combinations adopt the same shape, and tinkering with the mix changes the frequency of the light the crystal absorbs best.

Dr Snaith's perovskite is a particularly sophisticated one. It has an organic part, made of carbon, hydrogen and nitrogen, and an inorganic part, made of lead, iodine and chlorine. The organic part acts as a dye, absorbing lots of sunlight. The inorganic part helps conduct the electrons thus released.

It is also cheap to make. Purifying silicon requires high (and therefore costly) temperatures. Dr Snaith's perovskite can be blended at room temperature. Laboratory versions of cells made from it cost about 40 cents per watt (ie, about half the cost of commercial silicon-based solar cells). At an industrial scale, Dr Snaith expects, that will halve again.

There are caveats, of course. The new perovskite is such a recent invention that its durability has not been properly tested. Many otherwise-promising materials fail to survive constant exposure to the sun, a *sine qua non* of being a solar cell. And the process of converting a laboratory-made cell into a mass-manufactured one is not always straight forward.

If it leaps these hurdles, though, Dr Snaith's material will be a strong challenger for silicon. As solar power-generation becomes a mainstream technology over the next few years, the once-strange word "perovskite" may enter everyday language.