Plasmas are used around us – in the workaday world, in the aurora borealis and aurora australis (northern and southern lights) – and in the more exotic, such as in galactic explosions. So how do we use nanomaterials safely without wasting energy? Do we know? Plasmas are made when gases are superheated to millions of degrees Celsius.

**Where will the nanoscience revolution take us?**

**Nanomaterials** are making mega-waves in almost every field of endeavour, from food and water, health and environment to national security and space exploration. Built from atoms and molecules by molecule, these materials are five times smaller than the width of a human hair. While their miniscule scale gives them their unique properties, it also makes them rather difficult to work with and can even make them toxic. Because they are so small, nanomaterials can get into places they aren’t meant to be. They can pass through protective barriers like skin and cell walls and can interfere with the complex mechanics going on within the cells of plants and animals. Although they have the potential to help solve our energy crises, their manufacture tends to use a lot of energy. So how do we use nanomaterials safely without wasting energy?

Plasma may provide some solutions. Plasma is not a particular substance but is in the state of a substance under certain conditions. Water, for example, is in the solid state at 25°C and the gas state at 190°C.

Plasma is the next hottest state of matter, formed when the temperatures are high enough to make bits of the atoms inside it fall off. The result is a state of matter with unique properties and it may be the next big thing in nanoscience.

Plasma can be used to replace the vast amounts of liquid chemicals normally used to manufacture nanomaterials. These liquids are often toxic, expensive and difficult to recycle or dispose of safely, so replacing them reduces the dangers to workers and the environment. Plasmas are usually made and used in confined chambers and clean rooms so any toxic substances going into or coming out of the plasma are safely isolated.

Another advantage of plasmas is their energy efficiency – already existing in energy-efficient light bulbs. Almost all of the energy used to generate a plasma is retained by the plasma as a sort of energy soup and this, coupled with plasma’s other characteristics like electrical conductivity and high temperatures, makes the construction of nanomaterials in plasma a much less energy-guzzling process than when performed in liquids. Plasmas may even help solve our global energy crisis. At the National Ignition Facility in the US state of California, researchers are using plasmas to generate a potentially inexhaustible source of energy called Inertial Fusion Energy. If successful, IFE could keep a plasma dense and hot long enough for the particles within it to undergo nuclear fusion – a holy grail of science for more than 50 years and a contender to solve our future energy needs.

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