Nano machine of the future captures great scientist's bold vision

February 1 2007

An idea conceived by one of the world's greatest scientists nearly 150 years ago has finally been realised with a tiny machine that could eventually lead to lasers moving objects remotely.

James Clerk Maxwell, who is ranked along Isaac Newton and Albert Einstein for his contributions to science, imagined an atom-sized device -- known as Maxwell's Demon -- that could trap molecules as they move in a specific direction.

Now scientists at the University of Edinburgh, inspired by Maxwell's thought experiment in 1867, have been able to create such a "nanomachine" for the first time with their own "demon" inside it to ensnare the molecules as they move.

The work, published in the 1 February issue of the journal *Nature*, could ultimately lead to scientists harnessing the energy of the molecules to displace solid objects from a distance.

Professor David Leigh, of the University of Edinburgh's School of Chemistry, said: "Our machine has a device -- or 'demon' if you like -- inside it that traps molecule-sized particles as they move in a certain direction. Maxwell reasoned that if such a system could ever be made it would need energy to work. Without energy, it might appear that the perpetual motion of the molecules could power other devices in the same way as a windmill, but Maxwell reasoned that this would go against the second law of thermodynamics.

"As he predicted, the machine does need energy and in our experiment it is powered by light. While light has previously been used to energise tiny particles directly, this is the first time that a system has been devised to trap molecules as they move in a certain direction under their natural motion. Once the molecules are trapped they cannot escape."

Applications of the nanotechnology machine could include trapping molecules to generate a force in front of a solid object using a laser pen. By shining the pen in the direction you want the object to move, the force of the molecules could be harnessed to push the object along.

The invention of the nanotechnology machine builds on previous work at the university in which scientists were able to move a droplet of liquid up a slope using molecular force.

"Last year was the 175th anniversary of James Clerk Maxwell's birth in Edinburgh, so it is fitting that advances in science mean that we can finally create a machine like the hypothetical one he pondered over so long ago," said Prof Leigh.

"Maxwell was instrumental to our understanding of light, heat, and the behaviour of atoms and molecules. Without the foundations that he laid down a century-and-a-half ago, the science that we are doing today would not have been possible."

Source: University of Edinburgh