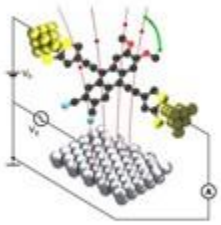
World record: one-molecule electric motor



Researchers from Delft University of Technology (Netherlands) and the Foundation for Fundamental Research on Matter have produced a design for the smallest electric motor in the world. The motor consists of just a single molecule and is not fuelled by light or heat (as is the case for previous designs), but by an electric field. As the field can be applied locally, it is possible to power just a single molecule. The speed of the motor can be accurately controlled by adjusting the frequency of the electric field. In principle, speeds to in the GHz range should be possible. The findings were published recently in ACS Nano.

The motor consists of a molecule that is placed above a gate-electrode and clamped between two gold electrodes. The central part of the molecule, the rotor, has a dipolar moment. The rotor can be set in motion by applying an alternating voltage across the gate. One of the greatest challenges of molecular motors is detecting the rotation, especially if it concerns a single molecule. The proposed motor uses the sensitivity of the resistance to determine the rotor position. At rest, the resistance is low. However, if the rotor rotates with respect to the rest of the molecule then the resistance shoots up. This makes it possible to measure the movement of the motor in real time.

For the time being the motor is only a concept, although certain aspects of the design have been experimentally confirmed. Calculations reveal that it should be possible to fuel and measure the proposed motor using existing measurement set-ups. The researchers are now working hard on realising the design. Possible applications are still a long way off, but include pump-like transport mechanisms similar to those found in the membranes of living cells.