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Plate tectonics: why only on Earth?

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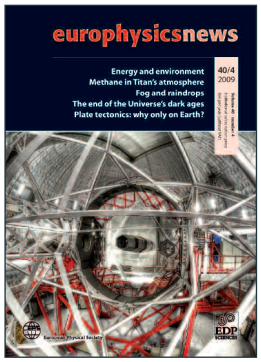

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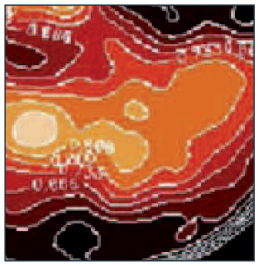
Cover picture: The world's biggest time machine was recently inaugurated. The Gran Telescopio CANARIAS (GTC) has celebrated its official opening on July 24th at the Observatorio del Roque de los Muchachos, and was attended by Their Majesties the King and Queen of Spain.



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Methane in Titan's atmosphere

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The end of the Universe's dark ages

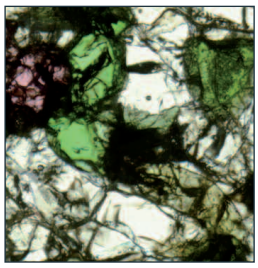

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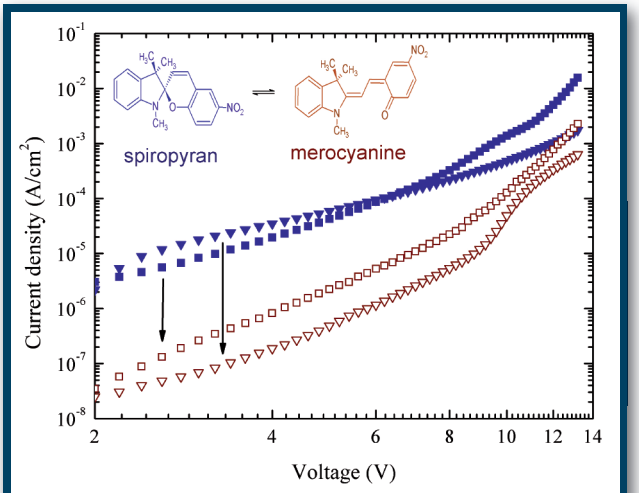
Plate tectonics: Why only on Earth

Carrier mobility switching in polymers

This paper reports on a switching device based on reversible modulation of charge carrier mobility by photochromic additive distributed in a polymer matrix. The light induced photochromic conversion of the additive is accompanied by significant increase of its dipole moment. The presence of the dipole moment induces a change of electrostatic potential in its vicinity and shifts the site energies of individual polymer repeating units. Since the position and orientation of the photochromic additive with respect to the polymer chain are essentially random the effect results in broadening of the distribution of the transport states and consequently in the lowering of the charge carriers mobility. These notions suggested by quantum chemistry modeling are proved by experimental characterization of the optical and electrical switching properties of the suggested switch. The observed current-voltage characteristics showed reversible decrease of the currents after the photochromic switching of the additive to its metastable state with high dipole moment. This behaviour was explained on the basis of charge carrier mobility decrease due to the presence of charge traps. Impedance spectroscopy revealed a drop of the bulk conductivity when the polar state of the photochromic molecules was present. The induced conductivity decrease is proportional to the drop observed by current-voltage characterization. ■

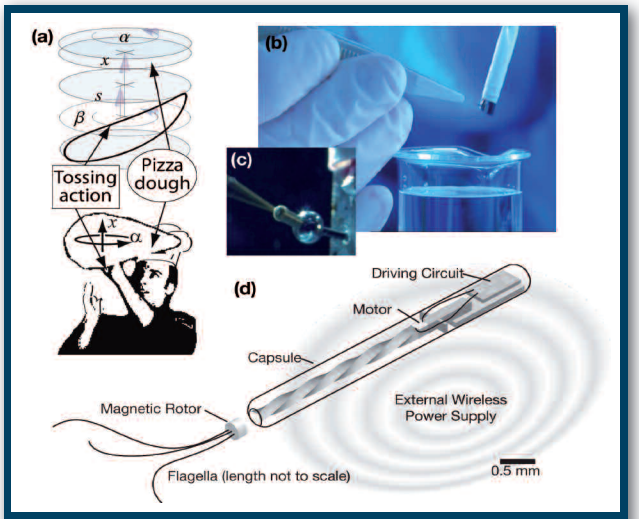
M. Weiter, J. Navrátil, M. Vala and **P. Toman**, 'Photoinduced Reversible Switching of Charge Carrier Mobility in Conjugated Polymers', *Eur. Phys. J. Appl. Phys.* **48**, 10401 (2009).



▲ Light-induced decrease of the current of the MDMO-PPV doped by spiropyran for different concentration of the dopant: 5% (square) and 10% (triangle). The full symbols represents the j-V behaviour of the beginning state of the system (ON state), whereas the open symbols describe the state after the photochromic conversion (OFF state).

Physics of pizza tossing **for micro-motors**

Originally a simple pedagogical tool in explaining how our new micro-motors work, pizza tossing grew to become an integral part of our analysis once we realized that the analogy between the two systems was far more than coincidental. By using pizza dough in place of the rotor, and deriving and solving the strongly nonlinear equations describing the way the dough travels through the air, we were able to determine how much and how quickly the dough rotates, and the energy efficiency of the toss itself.



► The (a) physical representation of a pizza toss helps in the design of (b,c) micro-motors for (d) swimming micro-robots.

Briefly, if one tosses the dough one toss at a time–that is, if one tosses then catches–the hands should move in a helical fashion. If one tosses the dough continuously, not stopping its spin every time, then the hands should move continuously in circles. The model was developed to understand the contact dynamics within our 250-micron-diameter standing wave ultrasonic micro-motors (SWUMs), intended for propelling flagella in micro-robots to swim through the bloodstream, potentially revolutionizing future surgical procedures.
The hands tossing the dough represent the vibrating stator of the SWUM while the dough represents the rotor. The difference is only in the details: a chef tosses dough, about once a second, a few tens of centimeters into the air, while a SWUM tosses the rotor around a few million times a second a few hundred nanometers away from the stator. Until now, trial and error has been used to design such motors without an adequate understanding of the forces involved. ■

K-C. Liu, J. Friend and **L. Yeo**, 'The behaviour of bouncing disks and pizza tossing.' *EPL* **85** 60002 (2009).