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Magical bolts from a fingertip

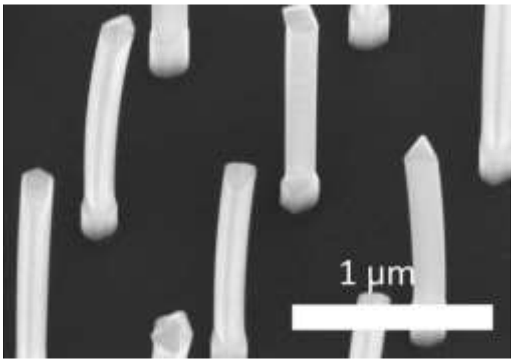
Scientists at Lund University proposed the use of piezocrystals for the conversion of solar energy to electricity. A present project tries to prove that experimentally.

When I was a boy and saw the shimmering color of a broken lighter in the corner of a sidewalk, I always checked for the part that generates those small sparks when you click it. At that time this item seemed somehow magical – the pressure of my finger caused a tiny spark! The things you could do with that spark to peeve or startle others … a precious item for a boy.

As so often in life, magic disappears when it is replaced by knowledge and today I know that the spark was caused by a piezoelectric crystal. Such crystals turn into an electric dipole when they are deformed. An electric dipole has a positive and a negative pole. Between them, an electric field is formed (analogous to a magnet with a south, and north pole with a magnetic field between them). The field in piezocrystals can grow so strong that it moves electrons within the material, creating a charge. This charge can then jump to regions that are not charged – the phenomenon of bolts and sparks.

Scientists at Lund University wondered wether piezocrystals could be used for the conversion of sunlight into electrical currents. The mechanism would be as follows: A piezocrystal is steadily deformed and thus creating a steady electric field. When sunlight shines on the piezocrystal, it creates a charge somewhere inside the crystal. The electrical field inside the crystal then moves this charge and voilà! A tiny and spark, which can now be used as electricity. And indeed, a computational model of the piezocrystal described above revealed that piezocrystals could be used for solar energy conversion. However, the structures need to be very small to resist the stress.

My project at Lund University



What a great motivation to actually produce piezocrystals and show that they can do this! I took the chance and joined the project at the department of Solid State Physics at Lund University. We produced tiny piezocrystals in the shape of towers, called nanowires (see figure). They are so small that they cannot be seen with the eye, only with an electron microscope. To better imagine how small they are, hold your thumb and index finger one millimetre away from each other. Now imagine to divide that space in a thousand parts – that will give you one micrometer (=µm; see figure). Then we covered the nanowires with a shell that deforms the piezocrystal-nanowires and creates an electric field inside them. Then took some nanowires with a sharp tip of a tissue tip, placed them on a chip and made tiny nickel-contacts to individual nanowires (it is simply stunning what the technical progress in the last decades allows nowadays). Although we had hoped to measure the field in piezocrystal-nanowires in this way, so far we have not been able to fully prove it.
For now, it remains somehow … magical.

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