Assembling micro-components with laser tweezers

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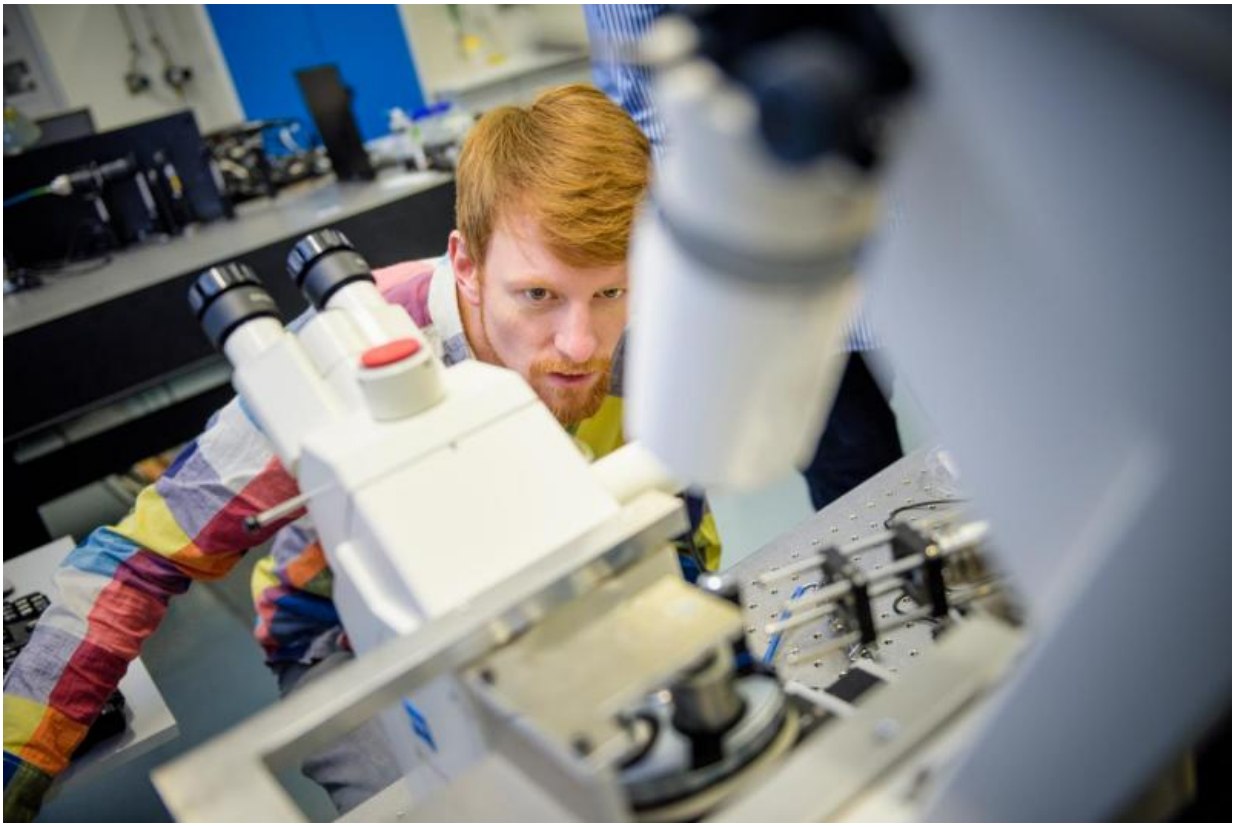

Working with optical tweezers is daily routine for PhD student Jannis Köhler. He uses the tool for testing the manipulation of rotatable microstructures. Credit: RUB, Damian Gorczany

A team of engineers headed by Prof Dr Cemal Esen from the Applied

Laser Technologies lab at the Ruhr-Universität Bochum develop microscopic components and assemble them to larger objects with the aid of laser tweezers. They are thus establishing methods that one day may be utilised to manufacture machines in dimensions of a few micrometres. The group has successfully tested several fastening techniques. At present, the researchers are experimenting with doped materials which can be used for rendering objects magnetic or giving them electrically conductive properties.

Using laser tweezers, engineers from Bochum assemble microscopic components to larger structures. One day, this method may be used for building micro-robots.

The team headed by Prof Dr Cemal Esen from the Applied Laser Technologies lab at the Ruhr-Universität Bochum (RUB) develops microscopic components that can be assembled with the aid of laser beams to form larger structures. The engineers are establishing methods which one day may be used for manufacturing structures and machines whose dimensions do not exceed a few micrometres.

Basis for sophisticated technology

In order to assemble components, the group utilises so-called optical tweezers, the arms of which are made up of strongly focused light. With its aid, they are able to manipulate objects in dimensions ranging between 0.5 and 20 micrometres. In future, this method could be used for manufacturing highly sophisticated technology. "It is conceivable that such modules could be used to build micro-robots," as engineer Sarah Ksouri describes one of the visions. "Such systems could be used for minimal invasive surgery."

Reversible connections

The challenge is to design individual components that can be connected, but also disassembled, if required. To this end, the researchers take their cue from the large world. Sarah Ksouri has demonstrated that the technology can be used to connect microscopic jigsaw puzzles pieces that stick together because of their shape. RUB researcher Jannis Köhler assembled rotating structures with optical tweezers.

The researchers developed the components in their Bochum laboratory using two-photon polymerization technique, a type of micro 3D printer. All spots indicated by a computer model in a drop of photoresist are exposed to a laser beam. This is how the required solid object is created.

Combining methods

The team at the Applied Laser Technologies lab simultaneously researches a number of different principles for combining two-photon polymerisation and optical tweezers in a feasible manner. At present, additional experiments with doped materials are carried out. Those materials are enriched with nanoparticles from certain elements which lend the polymer structures a specific function, for example by giving them magnetic or electrically conducting properties. Two-photon polymerisation, optical tweezers and nano-doping – these are the methods the Bochum researchers hope to integrate in one device one day.

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