Scientists demonstrate the performance of a new nanoprinting technique

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Scientists at the IBM Research – Zurich Laboratory in collaboration with the ETH Zurich have succeeded in positioning so-called nanotubes — measuring only 25 by 80 nanometers — on a surface in a highly precise and systematic manner using a special nanoscale orientation and printing process. To prove that their method works, the scientists constructed a standing and a walking Ampelmännchen (pedestrian pictogram on traffic lights) of selectively oriented gold nanotubes. An interesting application of this method could be as counterfeit-proofing of valuable items such as watches, jewellery or works of art.

The scientific journal *Advanced Functional Materials* featured an article describing this work in its 22 February 2012 issue. Researchers have developed a nanoscale orientation and printing process that allows them to print any arbitrary pattern with a resolution of individial particles. The publication describes how this method even allows oblong nanotubes to be oriented specifically in the same direction — lengthwise or crosswise — while preserving the often unique properties of the nanotubes.

Dr. Heiko Wolf, head of the project team at IBM Research – Zurich explains, "We use the surface tension of water and a nanostructure template to orient the nanotubes. They can then be transferred to any given surface via a nanoprinting process."

Such nanotubes, which are smaller than 100 nanometers, often have unique properties. The nonspherical particles are of interest because certain properties can be exploited depending on their orientation. For

example, the optical properties of the gold nanotubes used in these experiments can be targeted. Observed through a polarization filter, the color of the light changes depending on the orientation of the tubes relative to the filter. In this manner, scientists succeeded in creating a standing red Ampelmännchen and a walking green one of the same kind of nanotubes, but oriented in different directions. Measuring only 60 micrometers, the Ampelmännchen® are roughly 2500 times smaller than the originals.

Suitable processes to apply a large number of nanostructures or functional particles to surfaces in an efficient and precise manner are essential for the practical application of many nanotechnology innovations. This sophisticated printing technique constitutes a versatile and powerful fabrication method that could lend itself to such commercial appliations as counterfeit-proofing or in the electronics and IT sectors or for energy technology.

Provided by IBM