Nano Focus

Gold nanoparticles tailored to visualize fingerprints in reverse

When forensic scientists attempt to visualize latent fingerprints, they typically rely on reagents that respond to amino acids or sebaceous materials. This type of visualization makes fingerprint ridges more apparent, but the quality of the print is highly reliant on the amount of residue left behind. As Sanaa Shenawi, Nimer Jaber, Joseph Almog, and Daniel Mandler from the Hebrew University of Jerusalem have reported in the May issue of *Chemical Communications* (DOI: 10.1039/c3cc41610k; p. 3688), fingerprints on paper can now be visualized with a chemical method that enhances the areas of the paper that are not covered by sebaceous matter. With this technique, the sebaceous material serves as a mask that protects the paper from the chemical reaction, and the prints appear as a "negative" or "reversed" image. According to Almog, "Despite the plethora of quite sophisticated fingerprint reagents that currently exist, there is still a need for more sensitive ones, since in criminal investigations, a considerable portion of the latent prints still escape detection."

Gold nanoparticles were capped with various mercaptocarboxylic acids. This class of acids contains thiol groups, which can readily bind to gold, and carboxylic groups, which can form hydrogen bonds with cellulose. After preparing strips of paper with fingerprint marks, the strips were placed into a nanoparticle solution for a few minutes. Afterwards, a silver developer was used to make the fingerprints apparent. Developing is based on localized electroless silver deposition catalyzed by the gold nanoparticles. Thus, silver deposits almost exclusively on the areas where the gold nanoparticles were previously attached. The location of this step was found to depend on the actual ligand used with the gold.

When short-chain ligands were used, strong hydrogen bonds formed between the ligands and the cellulose in the paper. As a result, the paper was coated with gold, except the sebaceous areas. After applying the silver, a reversed fingerprint appeared, because the silver coated everything except for the sebaceous areas. The best ligand for reverse imaging proved to be 3-mercaptopropionic acid. When it was used, fingerprints as old as 14 months were developed with high contrast. However, when longer chain ligands were used on the gold, the nanoparticles developed a stronger affinity toward the sebaceous ridges. Thus, after treatment with silver, the fingerprint ridges were stained instead of the cellulose areas.

The researchers said that this new "reversed" method to developing fingerprints is a step forward in the science, since it is less reliant on the content of the sebaceous materials than other current visualization methods.

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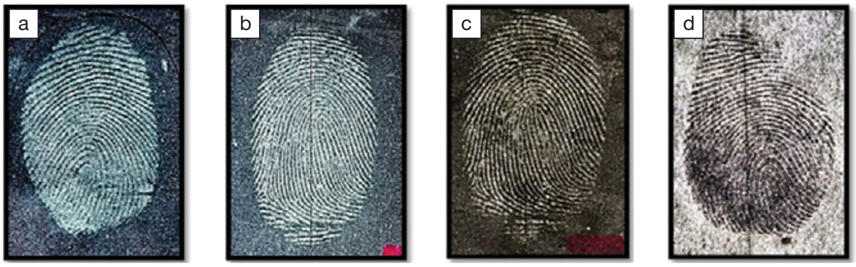

The images of fingerprints were developed by treatment with gold nanoparticles capped with different mercaptocarboxylic acids followed by silver deposition: (a) 3-mercaptopropionic acid on fresh print; (b) 3-mercaptopropionic acid on 14-month-old print; (c) 4-mercaptobenzoic acid on fresh print; and (d) 11-mercaptoundecanoic acid on fresh print produces "positive" print, not a "reversed" print, unlike the prior three images. Reproduced with permission from *Chem. Commun.* DOI: 10.1039/c3cc41610k; p. 3688. © 2013 The Royal Society of Chemistry.

Bio Focus

Is zinc the perfect material for bioabsorbable stents?

To help with narrowed or obstructed arteries, surgeons typically perform balloon angioplasty, a procedure that first widens the blood vessels with a balloon and then keeps them propped open with a wire mesh called a stent. The metal stents permanently stay in the body, potentially causing issues such as chronic inflammation and local clotting. Scientists have now discovered that stents made from bioabsorbable zinc could be exactly what clinicians and patients need—they could give arteries enough time to heal but not linger in the body long enough to cause additional problems.

"We found that the degradation rate of zinc is perfect," said Jaroslaw Drelich, a materials researcher at the Michigan Technological University and co-author of the new study, published in the May 14 issue of *Advanced Materials* (DOI: 10.1002/adma.201300226; p. 2577).

In the last decade, scientists have looked into the efficacy of bioabsorbable stents, focusing on iron- and magnesium-based stents. Iron stents are not ideal because the material produces a large volume of potentially hazardous iron oxide, which does not degrade easily in the human body. And magnesium is innocuous but dissolves in the body much too quickly. The research team decided to start with a different metal as a base material. They chose zinc because previous research has shown that zinc can help slow down the biodegradation process when added to other materials.

To test the biodegradation properties of metallic zinc, graduate student Patrick Bowen crafted 15-mm-long zinc wires. The wires, which were less than half a millimeter in diameter, did not comprise a full stent—they represented a supportive portion of the stent called a

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