Detecting fluorescence signals from nanoscale thin films: New possibilities in product labeling

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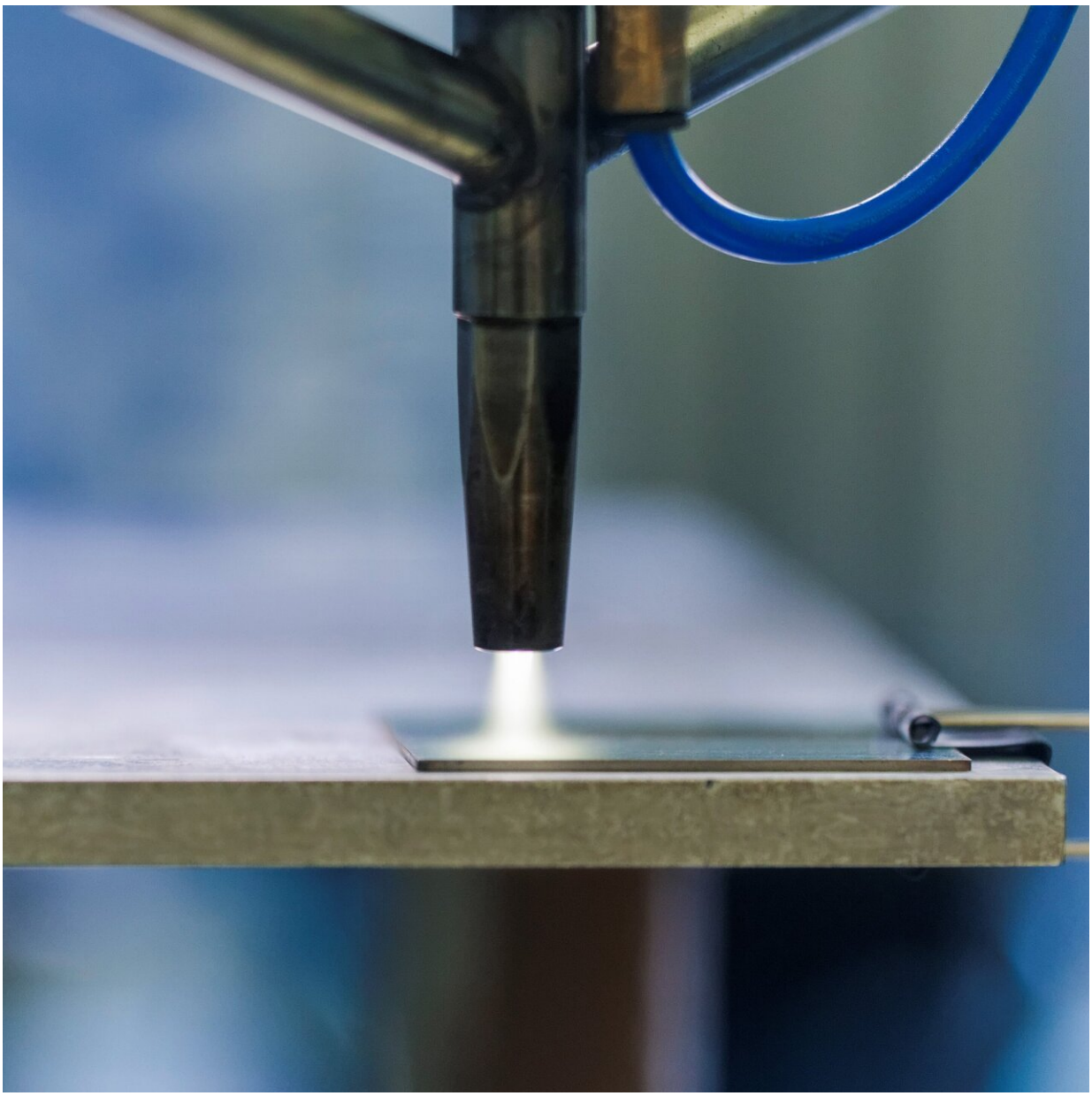

Layer deposition using a plasma jet. Credit: INNOVENT e.V.

Researchers from INNOVENT e.V. and Ferdinand-Braun-Institut gGmbH have developed a measurement technique to detect nanoscale fluorescent thin films for the first time without using expensive laboratory equipment. Fluorescent thin films are used in areas such as security, logistics and merchandise management.

The Jena-based industrial research institution INNOVENT e.V. has incorporated fluorescent nanoparticles into thin-film technologies. These particles can now be detected thanks to a special measurement method developed at the Ferdinand-Braun-Institut (FBH) in Berlin. This was not possible previously because the fluorescent materials have very low intensity signals. The technology is based on plasma and sol-gel coatings. The team hopes to further develop the patented nano-fluorescence technology so that it can be used commercially with a handheld device and mobile app in the future.

The novel coatings can be made invisible to the eye and customized to the respective applications. For example, the functionality of the surface can be designed as a barrier layer to prevent metals from corroding or to make films impermeable to gases. Easy-to-clean layers can also be created in this way, equipped with special hydrophilic, hydrophobic or antimicrobial properties. Very low concentrations of the nanoparticles—less than 0.5 %—need to be introduced into the 200–500 nm thin layers. This guarantees that materials are used economically and ensures that the labeled products are recyclable.

The verification process

For the high sensitivity detection of nanoscale fluorescent thin films, the layers are excited using UV light, which is detected by a photodetector with an optical filter. The fluorescence can be measured within a few seconds as successfully demonstrated in a laboratory setup. In the future, such sensitive measurements will no longer have to be carried out in the laboratory thanks to the small size of the components. They could be performed directly in production areas, in logistics companies or at customs offices, because the laboratory setup is so compact that it is suitable for mobile applications. The detection unit can be constructed as a miniaturized system to identify specific dyes or as a standardized "universal system" with interchangeable LEDs and/or filters.

New possibilities for product labeling

The patented nano-fluorescence technology offers companies that use functional thin-film coatings and label products new opportunities. Coatings can be deposited over small or large areas, depending on the product, and dyes can be used economically. Identifications such as logos or barcodes can be "engraved" by laser into these color-coated surfaces for "track & trace" products. These markings with line widths of a few micrometers can be detected with a handheld fluorescence detection system. The coatings themselves adhere to a variety of materials such as plastics, metals, glass/ceramics, lightweight and 3D printed products.

The markings can also be used in-house for managing semi-finished product logistics and for organizational purposes in supply chains. The technology is equally suitable for product labeling—as a certificate of authenticity for mass-produced items as well as customizable labeling for high-value products. Combinations or variations of the fluorescent materials and "engravings" can be used to increase flexibility. The patent-protected coatings can also be licensed to interested companies.

Provided by INNOVENT e.V. Technologieentwicklung Jena

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