Researchers develop unique printing technology for 'invisible' images

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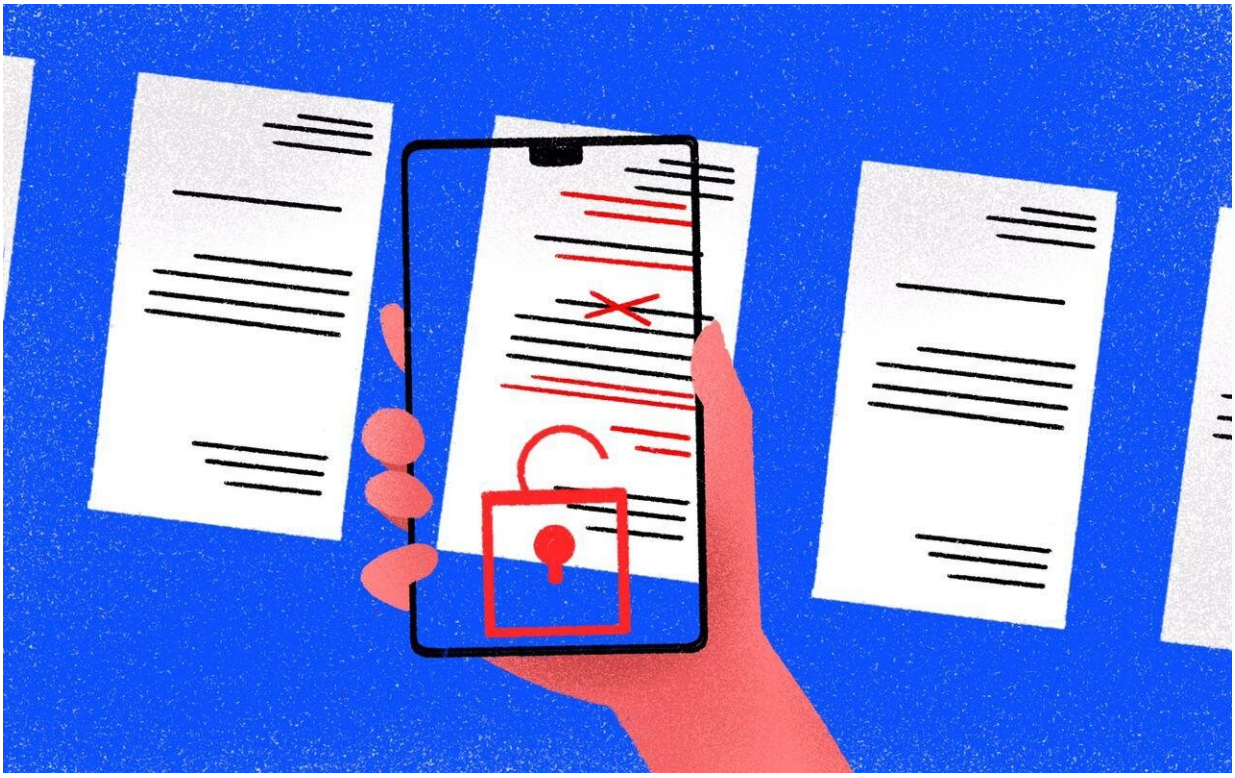

Credit: Dmitry Lisovsky, ITMO

Researchers from ITMO University's ChemBio Cluster have developed an inkjet printing technology that makes it possible to produce images that can only be seen in polarized light—such as when using a smartphone screen. The new technology will help manufacturers protect

their products from forgery. An article concerning the technology was published in *ACS Applied Material Interfaces*.

In order to achieve these results, the researchers have spent five years working on a way to use solution chemistry methods to apply high-resolution organized nanostructures. In large part, the ability to produce images invisible to the naked eye is due to the creation of special colloidal ink based on nanoscale cellulose particles capable of orienting themselves on a surface in a special manner.

"The market for printing materials that can protect products from forgery and counterfeiting is growing at a geometric rate. To that end, manufacturers use various QR codes and data signals, but it would be preferable to have methods that are more accessible and don't require major investments. Using inkjet printing can make the process of launching the production of packaging material significantly simpler, but it calls for serious multi-year research into the chemical composition of the ink," explains Alexander Vinogradov, head of ITMO University's ChemBio Cluster.

While the distribution of nanoparticles is chaotic under regular conditions, the use of this special inkjet printing method results in a nanoarchitecture in which particles are strictly parallel in relation to each other. The thickness of such coatings, which forms as ink settles, is chosen so as to allow for certain optical phenomena observed under polarized light. Thus, the colorful optical response from the printed image can be easily observed through any LCD screen, including that of a smartphone.

"This effect is achieved by programming the nanoparticles contained within the solution; we imbue them with certain qualities in advance, knowing their charge and ionic force, the properties of the solution and keeping in mind what these parameters need to be during printing," says

Alexander Vinogradov. "With all that in mind, we pick the right concentration of ink and modify it so that the dynamics of the nanoparticles and their mutual attraction and repulsion wouldn't allow them to distribute chaotically, assembling them parallel to each other instead."

Any full-color transparent image can be printed in this manner—a number, letter or a logo. These watermarks could potentially be used for added security of products, banknotes, tickets, and similar items.

More information: Elena Eremeeva et al. Printing of Colorful Cellulose Nanocrystalline Patterns Visible in Linearly Polarized Light, *ACS Applied Materials & Interfaces* (2020). DOI: 10.1021/acsami.0c11846

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