Researchers develop molecular backbone of super-slim, bendable digital displays

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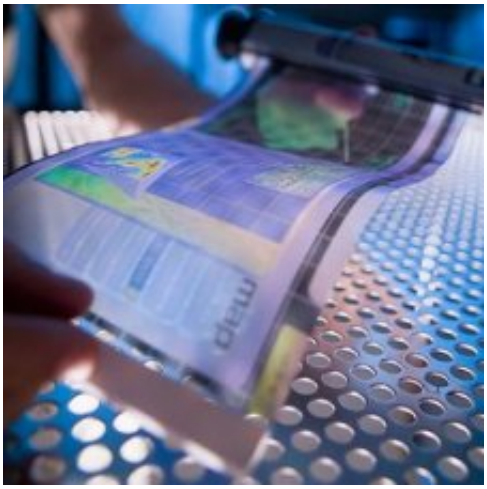

From smartphones and tablets to computer monitors and interactive TV screens, electronic displays are everywhere. As the demand for instant, constant communication grows, so too does the urgency for more convenient portable devices—especially devices, like computer displays, that can be easily rolled up and put away, rather than requiring a flat surface for storage and transportation.

A new Tel Aviv University study, published recently in *Nature Nanotechnology*, suggests that a novel DNA-peptide structure can be used to produce thin, transparent, and flexible screens. The research, conducted by Prof. Ehud Gazit and doctoral student Or Berger of the

Department of Molecular Microbiology and Biotechnology at TAU's Faculty of Life Sciences, in collaboration with Dr. Yuval Ebenstein and Prof. Fernando Patolsky of the School of Chemistry at TAU's Faculty of Exact Sciences, harnesses bionanotechnology to emit a full range of colors in one pliable pixel layer—as opposed to the several rigid layers that constitute today's screens.

"Our material is light, organic, and environmentally friendly," said Prof. Gazit. "It is flexible, and a single layer emits the same range of light that requires several layers today. By using only one layer, you can minimize production costs dramatically, which will lead to lower prices for consumers as well."

From genes to screens

For the purpose of the study, a part of Berger's Ph.D. thesis, the researchers tested different combinations of peptides: short protein fragments, embedded with DNA elements which facilitate the self-assembly of a unique molecular architecture.

Peptides and DNA are two of the most basic building blocks of life. Each cell of every life form is composed of such building blocks. In the field of bionanotechnology, scientists utilize these building blocks to develop novel technologies with properties not available for inorganic materials such as plastic and metal.

"Our lab has been working on peptide nanotechnology for over a decade, but DNA nanotechnology is a distinct and fascinating field as well. When I started my doctoral studies, I wanted to try and converge the two approaches," said Berger. "In this study, we focused on PNA - peptide nucleic acid, a synthetic hybrid molecule of peptides and DNA. We designed and synthesized different PNA sequences, and tried to build nano-metric architectures with them."

Using methods such as electron microscopy and X-ray crystallography, the researchers discovered that three of the molecules they synthesized could self-assemble, in a few minutes, into ordered structures. The structures resembled the natural double-helix form of DNA, but also exhibited peptide characteristics. This resulted in a very unique molecular arrangement that reflects the duality of the new material.

"Once we discovered the DNA-like organization, we tested the ability of the structures to bind to DNA-specific fluorescent dyes," said Berger. "To our surprise, the control sample, with no added dye, emitted the same fluorescence as the variable. This proved that the organic structure is itself naturally fluorescent."

Over the rainbow

The structures were found to emit light in every color, as opposed to other fluorescent materials that shine only in one specific color. Moreover, light emission was observed also in response to electric voltage—which make it a perfect candidate for opto-electronic devices like display screens.

More information: Nature Nanotechnology, www.nature.com/nnano/journal/v … l/nnano.2015.27.html

Provided by Tel Aviv University