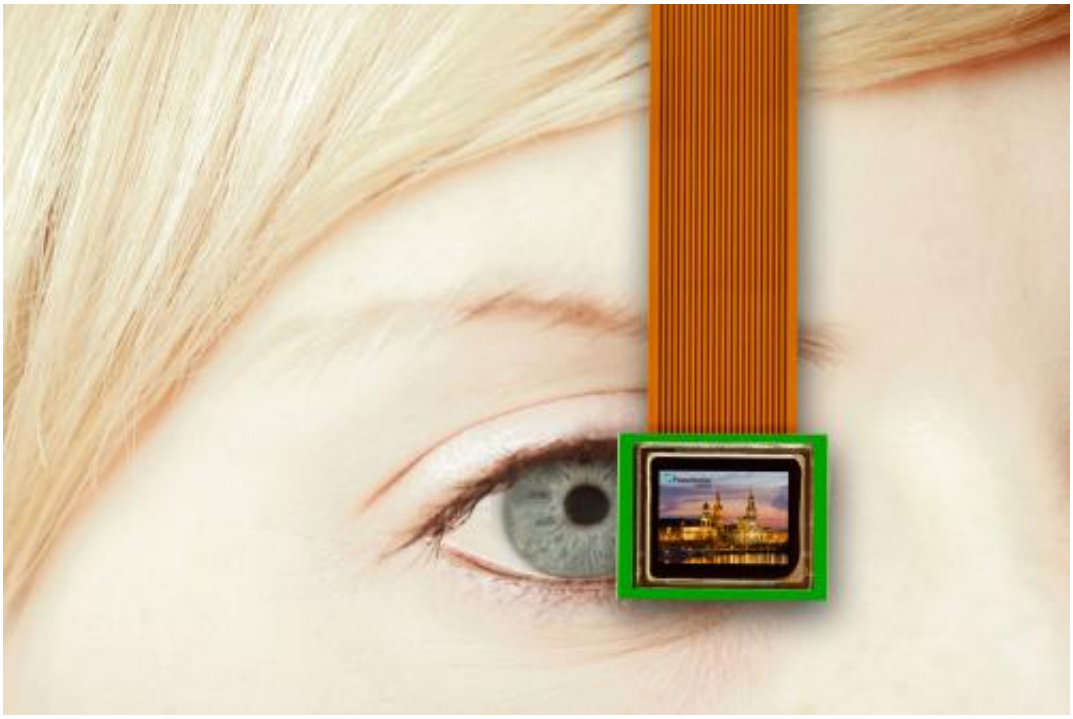
OLED brings out the shine

June 7 2013



Microdisplays are barely larger than the human eye. A new, cost-effective process now lets them shine markedly brighter. Credit: Fraunhofer COMEDD

Screens made of organic light diodes promise unfathomable possibilities. Yet high production costs often prevent their widespread use. A new kind of production saves not only costs, but also improves the radiance of the OLED.

The age of the good old cathode ray tube has long since passed. According to the German Federal Statistics Office, by 2011, almost

every other German household had a flat screen television. The question, however, is how long our boob tubes – measuring just a few centimeters thick – will manage to hold onto the moniker "flat." Rigo Herold of the Fraunhofer Research Institution for Organics, Materials and Electronic Devices COMEDD is already thinking in totally different dimensions in any case: "In 2008, the first manufacturers introduced displays that were less than a millimeter thick." The technology behind these incredibly narrow matt screens is called OLED. The abbreviation stands for "Organic Light Emitting Diode." "OLEDs emit light themselves, and unlike the ordinary liquid crystal display screens of today, they work without background lighting. For this reason, it will soon be possible to manufacture very thin and simultaneously very flexible, bendable displays," explains Herold, who is in charge of "IC and Systems Design" at COMEDD. What you previously knew only from science fiction flicks could also change our everyday viewing experience within the foreseeable future: Screens as thin as paper, applied to clothing, curtains and even windows.

Yet the technology is still in its infancy stages. Beside the minimal lifespan, up to now the extremely high acquisition costs are impeding a widespread breakthrough. "Producing organic light diodes is still very expensive. This is why you still cannot purchase large-scale OLED television screens currently. Right now, the technology is being used primarily for very small screen sizes of just a few square centimeters. Examples include the ViewFinder on digital cameras or – even smaller – on cellphone beamers and data glasses," as Herold describes the state of the art. Together with his colleagues, he is researching new production methods for microdisplays.

Subpixels applied directly onto microdisplays

The researchers recently achieved an important breakthrough in this area: Together with VON ARDENNE Anlagentechnik GmbH they are

developing a technology for producing mini-OLED screens without color filters. That makes the production process not only cheaper, but even improves the luminosity of the microdisplays. Until now, the color filter suppressed the self-radiance of the OLED, so that only about 20 percent of the emitted light could be used. Two negative effects from the filter sheet being used are responsible for this: First, it suppresses two of the three color ranges of an OLED subpixel; second, as an additional layer applied over the OLED, it automatically dims the generated light.

In order to circumvent the use of the color filter, the red, green and blue subpixels – which are integral to the depiction of a color image – must be loaded onto the OLED directly. That was previously impossible. "The subpixels in the tiny display are typically about 8 square micrometers in size. However, conventional technology only allowed for the processing of units greater than 50 square micrometers," says Herold, illustrating the challenge to be mastered. In order to resolve this set of problems, scientists employed a special technology made by VON ARDENNE, their partner company. This technology facilitates the targeted vaporization of organic layers locally, under heat. In this manner, surfaces can be processed that are smaller than 10 square micrometers. "In order to use the technology for OLED microdisplays, we redesigned the entire manufacturing process. It is therefore possible to load the red, green and blue color pixels directly. The use of the color filter is no longer necessary and it is possible to use 100 percent of the light emitted," says Herold.

Smartphones hold up longer

Still, the OLED not only shine brighter, the new production process is also less expensive. Color filters are very expensive to produce. Depending on the application, they have to be custom-designed, consist of suitable materials and be mounted properly. If the filter shifts, for instance, that could have a negative impact on the image quality.

"Ultimately, the consumer benefits as well: We all know that our mobile devices, like smartphones and digital cameras, consume a lot of energy each day. The less is used for the color presentation of the displays, the longer our batteries will last for telephone calls, surfing or taking pictures," Herold concludes.

Provided by Fraunhofer-Gesellschaft