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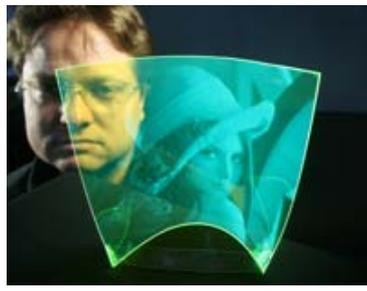
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## New Imaging Device That Is Flexible, Flat, and Transparent

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### Fluorescent light traveling through polymer sheet may lead to user interface devices that respond to gestures alone

Digital cameras, medical scanners, and other imaging technologies have advanced considerably during the past decade. Continuing this pace of innovation, an Austrian research team has developed an entirely new way of capturing images based on a flat, flexible, transparent, and potentially disposable polymer sheet. The team describes their new device and its possible applications in a paper published today in the **Optical Society's (OSA)** open-access journal *Optics Express*.

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The new imager, which resembles a flexible plastic film, uses fluorescent particles to capture incoming light and channel a portion of it to an array of sensors framing the sheet. With no electronics or internal components, the imager's elegant design makes it ideal for a new breed of imaging technologies, including user interface devices that can respond not to a touch, but merely to a simple gesture.

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“To our knowledge, we are the first to present an image sensor that is fully transparent – no integrated microstructures, such as circuits – and is flexible and scalable at the same time,” says Oliver Bimber of the **Johannes Kepler University Linz** in Austria, co-author of the *Optics Express* paper.

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The sensor is based on a polymer film known as a luminescent concentrator (LC), which is suffused with tiny fluorescent particles that absorb a very specific wavelength (blue light for example) and then reemit it at a longer wavelength (green light for example). Some of the reemitted fluorescent light is scattered out of the imager, but a portion of it travels throughout the interior of the film to the outer edges, where arrays of optical sensors (similar to 1-D pinhole cameras) capture the light. A computer then combines the signals to create a gray-scale image. "With fluorescence, a portion of the light that is reemitted actually stays inside the film," says Bimber. "This is the basic principle of our sensor."

For the luminescent concentrator to work as an imager, Bimber and his colleagues had to determine precisely where light was falling across the entire surface of the film. This was the major technical challenge because the polymer sheet cannot be divided into individual pixels like the CCD camera inside a smartphone. Instead, fluorescent light from all points across its surface travels to all the edge sensors. Calculating where each bit of light entered the imager would be like determining where along a subway line a passenger got on after the train reached its final destination and all the passengers exited at once.

The solution came from the phenomenon of light attenuation, or dimming, as it travels through the polymer. The longer it travels, the dimmer it becomes. So by measuring the relative brightness of light reaching the sensor array, it was possible to calculate where the light entered the film. This same principle has already been employed in an input device that tracks the location of a single laser point on a screen.

The researchers were able to scale up this basic principle by measuring how much light arrives from every direction at each position on the image sensor at the film's edge. They could then reconstruct the image by using a technique similar to X-ray computed tomography, more commonly known as a CT scan.

"In CT technology, it's impossible to reconstruct an image from a single measurement of X-ray attenuation along one scanning direction alone," says Bimber. "With a multiple of these measurements taken at different positions and directions, however, this becomes possible. Our system works in the same way, but where CT uses X-rays, our technique uses visible light."

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