Can you see me now? Flexible photodetectors could help sharpen photos

January 13 2009, by Liz Ahlberg

This example of a curved photodetector array was developed by University of Wisconsin-Madison Electrical and Computer Engineering Associate Professor Zhenqiang (Jack) Ma and colleagues. Inspired by the human eye, Ma's curved photodetector made of flexible germanium could eliminate the photo distortion that occurs in conventional photo lenses. Photo courtesy Zhenqiang Ma

(PhysOrg.com) -- Distorted cell-phone photos and big, clunky telephoto lenses could be things of the past. UW-Madison Electrical and Computer Engineering Associate Professor Zhenqiang (Jack) Ma and colleagues have developed a flexible light-sensitive material that could revolutionize photography and other imaging technologies.

Their technology is featured on the cover of the January 5 issue of *Applied Physics Letters*.

When a device records an image, light passes through a lens and lands on a photodetector -- a light-sensitive material like the sensor in a digital camera. However, a lens bends the light and curves the focusing plane. In a digital camera, the point where the focusing plane meets the flat sensor will be in focus, but the image becomes more distorted the farther it is from that focus point.

"If I take a picture with a cell phone camera, for example, there is distortion," says Ma. "The closer the subject is to the lens, the more distortion there is."

That's why some photos can turn out looking like images in a funhouse mirror, with an enlarged nose or a hand as big as a head.

High-end digital cameras correct this problem by incorporating multiple panes of glass to refract light and flatten the focusing plane. However, such lens systems -- like the mammoth telephoto lenses sports photographers use -- are large, bulky and expensive. Even high-quality lenses stretch the edges of an image somewhat.

Inspired by the human eye, Ma's curved photodetector could eliminate that distortion. In the eye, light enters though a single lens, but at the back of the eye, the image falls upon the curved retina, eliminating distortion. "If you can make a curved imaging plane, you just need one lens," says Ma. "That's why this development is extremely important."

Ma and his group can create curved photodetectors with specially fabricated nanomembranes -- extremely thin, flexible sheets of germanium, a very light-sensitive material often used in high-end imaging sensors. Researchers then can apply the nanomembranes to any polymer substrate, such as a thin, flexible piece of plastic. Currently, the group has demonstrated photodetectors curved in one direction, but Ma hopes next to develop hemispherical sensors.

"We can easily realize very high-density flexible and sensitive imaging arrays, because the photodetector material germanium itself is extremely bendable and extremely efficient in absorbing light," Ma adds.

Ma's co-authors include UW-Madison Materials Science and Engineering Professor Max Lagally and University of Michigan Professor Pallab Bhattacharya.

Provided by UW-Madison