Solar chip monitors windows

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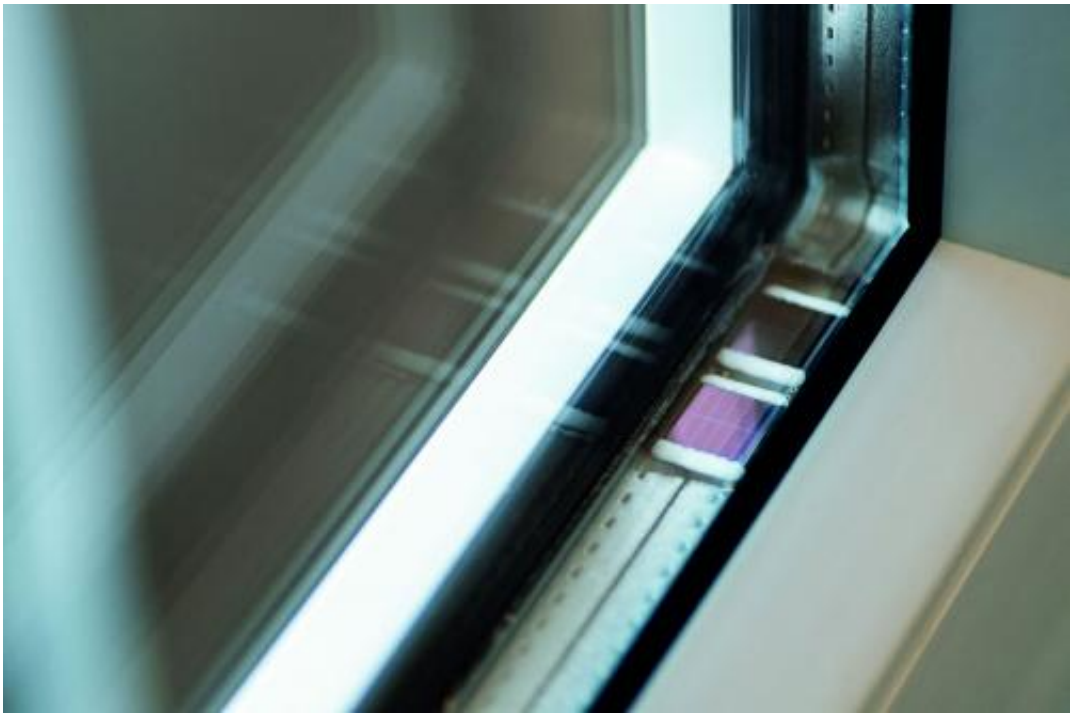

The chip affixed to the window frame supplies itself with energy. Credit: Fraunhofer IMS

A new kind of radio chip is intended to warn when windows are left open. This way, you can avoid having the heat go out the window on cold days. The sensor also detects break-in attempts early on. The key: This maintenance-free chip powers up with energy supplied by solar power.

It happens all too often in the cold times of the year: You open the window in the morning for fresh air and forget to shut it again. A

thermostat reports cold temperatures, and the heating is turned up full blast – right out the window. But open windows are a problem with more than just the heating or storms. A window tilted open, for example, is a direct invitation to intruders. It would be desirable to have an automated system that notices open windows and sends an alarm signal to the tenant. There are certainly home and building systems today that register the window status. As a rule, however, the sensors have to be attached by cable to the alarm center inside the home or building itself. In other cases, battery-operated radio sensors are used. But changing batteries in structures that have several windows can lead to a considerable maintenance expense. Researchers from the Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Duisburg therefore developed a pragmatic alternative: a radio sensor chip about the size of a fingernail that is mounted directly in the window. The tiny sensor is coated with a solar cell and it supplies itself with power.

Sensors differentiate between ball and crowbar

At ten millimeters, the chip is as narrow as a pane of insulating glass is thick. It is installed on the aluminum profile between the glass that maintains the distance between the panes. Thanks to this window space, the solar cell obtains adequate light, even in the darkness of winter. Integrated in the chip are magnet and acceleration sensors that register if the window is open just a crack or all the way. The chip can send a signal via radio to the base station in the building if a window has remained open for too long. The applications of the radio chip are diverse. It can remind homeowners to ventilate regularly or warn if a window is still open when they leave the home. In addition, it offers reliable protection from intruders even for closed windows. Because the sensors can differentiate very precisely between various fluctuations - for example, a ball that slams against the pane, or an intruder's crowbar that ratchets open the window frame. Within a tenth of a second, the system detects the disturbance and sounds the alarm if there is any doubt.

The IMS researchers around electrical engineer Dr. Gerd vom Bögel and physicist Dr. Andreas Goehlich have mastered just these two challenges: First of all, they succeeded in depositing the solar cell directly onto the uneven surface of the chip. Secondly, the chip consumes power so meagerly that energy from the miniscule solar cell spans the dark hours. The microchips are coated with numerous conductor paths, its surface is thereby made very uneven. "This is why we had to find a means of filling in and evening the surface, like a street profile, prior to coating it with the solar cell," vom Bögel says.

Currently IMS sensor prototypes can store enough power for up to 30 hours of darkness. This is expected to lead to the emergence of a product over the next two years that can even bridge up to two weeks of darkness. By keeping both processor and chip extremely small, the latter is extremely frugal. In addition, the researchers constructed switches that consume little energy, and engineered very short radio protocols. "We have extracted every possible micro-ampere," says vom Bögel. Adding to the overall conservation of power is the fact that the sensor always switches to sleep mode. Depending on the user's preferences, the sensor can be set so that it wakes up every few minutes, or even seconds, and takes a measurement. The Israeli firm SOLCHIP, which was asking for solar cells on chips at IMS around two years ago, provided the impetus to developing the solar radio chip. Andreas Goehlich's group of developers succeeded in integrating the solar cells on the surface of the chips. Using these solar cells, SOLCHIP seeks to monitor the street traffic for example, or the climate conditions in vine-
yards.

"As you can see, there are a lot of application areas," vom Bögel says. The production costs are so minimal because the application of the solar coating is directly connected to the production process of the chips. "Only a handful of additional production steps are needed so that manufacturing can also be accomplished in high quantities."

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