Romper suit to protect against SIDS

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Credit: Verhaert

Parents of newborn babies are always creeping into the nursery at night to check that their infant is still breathing. Alternatively, they might let the baby sleep in their room, hoping to notice any respiratory arrest and intervene before it is too late. A lack of answers is part of what makes sudden infant death syndrome (SIDS) so frightening. SIDS is the leading cause of death among infants one-month to one-year old and remains unexplained, despite years of research.

However, some relief may be on the way with an innovative romper suit which German scientists have created. This romper suit will have an integrated sensor systemto warn parents as soon as their child stops breathing. The cornerstone of the sensor system is a stretchable printed circuit board that fits to the contours of the body, making it hardly noticeable. It was developed by researchers at the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin. To demonstrate one of the many possible applications of the stretchable PCB, scientists have fitted it with two commercially available sensors and ironed the whole system onto a romper suit. This allows them to monitor breathing in the chest and stomach areas.

The circuit board made of polyurethane, is also known as PU. This is a cost-efficient material more commonly used for coating surfaces, as a sealant, or as a cushioning material. 'The circuit board we have developed can be manufactured using routine industrial processes, meaning a high throughput and, consequently, good cost-efficiency,' says Manuel Seckel, scientist at the IZM. 'Furthermore, components can be positioned on it just as precisely as on a standard board thanks to the stability of the stretchable substrate during processing. This stands in contrast to textile-based electronics, where one can expect an offset of up to five millimeters over a half-meter area.'

Researchers had to overcome a number of challenges to achieve the high level of accuracy required. One of these was how to handle and process the polyurethane. 'As with stretch fabric, PU PCBs are hard to machine manufacture because they tend to change shape. To counter this, scientist developed a support system on which the PU boards is place and machine process them before removing the support once more,' explains Seckel. The method is currently being tested by various industrial concerns.

However, the romper suit is just one of many potential applications for flexible circuit boards. For instance, the technology could also be used to provide subtle lighting in the roof lining of cars - "stars" on the car roof, for example. Equally, it could be set to work in the pressure bandages applied to burn wounds. Here, PU plasters equipped with integrated sensors would help nurses find the optimal placement for the bandage.

The stretchable circuit board is also the basis for a plaster being developed by medical scientists from the University of Heidelberg in collaboration with the Fraunhofer researchers. In future, doctors will be able to use this plaster to test the kidney function of their patients. Up to now, the procedure has involved injecting a substance that only the kidney is able to break down, and then taking blood samples roughly every 30 minutes over a three-hour period. If a kidney is healthy, it will almost completely break down the substance within three hours; if it is diseased, it will only manage a slow reduction in concentration. Equipped with a PU circuit board plaster, a blue LED and a detector, in future doctors will be able to spare patients a lot of jabbing - and examine them with much more precision.

As in the standard procedure, the investigation begins with the doctor injecting a substance, in this case an organic colorant. The blue LED causes this colorant to fluoresce, making it glow, a development in turn picked up by the detector located in the plaster. As the natural colorant is broken down by the kidney, the concentration of fluorescent radiation also decreases. 'The plaster allows doctors to continually monitor the concentration of the test substance, giving them a more accurate diagnosis than the standard check. In addition, the costs of the test can be reduced by up to 60 per cent,' says Seckel.

Already, there are plans for clinical trials, though it will be three to five years before the plaster can be used for kidney testing, which will make life easier for both doctors and patients.

More information: Fraunhofer Institute for Reliability and Microintegration IZM
www.izm.fraunhofer.de/en.html

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