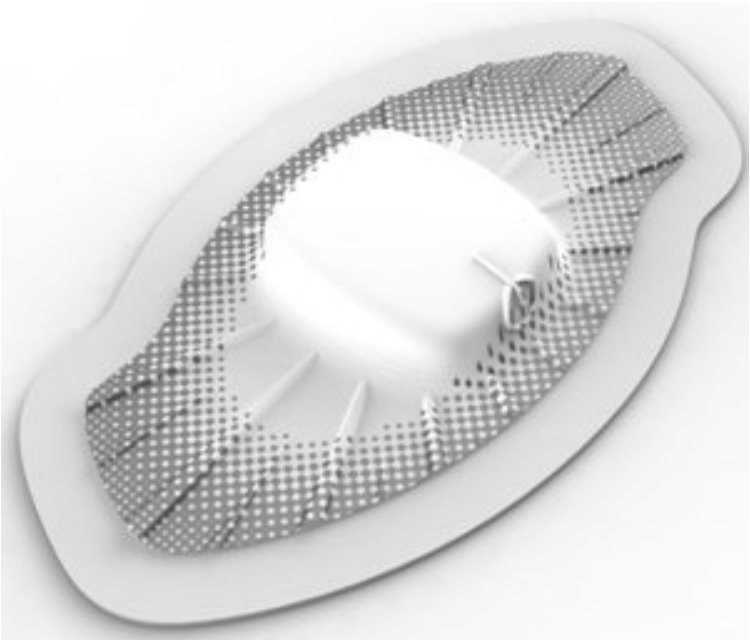
New Patch-Based Wearable Sensor Combines Advanced Skin Adhesives and Sensor Technologies

Deepak Prakash

Advances in adhesives, materials, software and sensor technologies are spurring development of a new generation of wearable sensors and monitors for medical and health management applications. A notable example is a patch-based wearable sensor that adheres comfortably to the user's skin and continuously gathers physiological and lifestyle information, with certain versions that will include vital signs and other indicators for up to seven days. The patch-based wearable sensor represents a major advancement in personal monitoring device design, functionality and wear time.



Metria™ patch-based wearable sensor. (Photo courtesy of Avery Dennison Medical Solutions.)

This innovative solution results from a close collaboration between three best in class partners: Avery Dennison Medical Solutions, a global leader in adhesive technologies and material sciences and complex manufacturing platforms for medical applications, Proteus Digital Health, Inc., a leading developer of wearable and ingestible sensing technology that helps people develop and sustain healthy habits, and BodyMedia, Inc., who brings its propriety algorithms and experience as

a pioneer and category leader in continuous on-body monitoring.

The device contains multiple sensors that enable monitoring of key health indicators including heart rate, respiration, steps taken, activity and sleep patterns. Data from the patch-based wearable sensor is uploaded to a computer or mobile device, providing a snapshot of the user's health. The information can be used to guide performance or behavioral modifications in support of sports and fitness or health and wellness goals.

A Collaborative Effort

At first, the patch-based wearable sensor project began between Proteus Digital Health and Avery Dennison Medical Solutions with the idea to combine Proteus' advanced sensor technologies with Avery Dennison Medical Solutions' expertise in skin-friendly adhesives and complex manufacturing platforms. The two companies identified a significant opportunity in the wearable sensor market and agreed to work together on a patch-based device with a differentiated set of performance characteristics. To support commercialization of the product, Avery Dennison Medical Solutions introduced the Metria™ Wearable Sensor Technology* platform, from which the initial product for consumer applications would be launched.

BodyMedia also joined the team soon after as Avery Dennison Medical Solutions' first commercial partner, bringing enhancements to the program that include sensor technology experience, validated algorithms and a vast portfolio of related intellectual property. The company develops armband-style body monitoring systems designed for longer-term use and viewed the patch-based wearable sensor concept as a complement to its existing weight management product line as well as new markets that BodyMedia will be entering with this platform. As part of the agreement, BodyMedia licensed to Avery Dennison Medical Solutions a proprietary suite of algorithms to track specific data such as energy expenditure, which would be incorporated into the product to monitor calories burned.

Once the basic form and features of the device were defined, product development activities accelerated. They consisted of four distinct but interrelated elements: materials development and selection, product and hardware design, manufacturing process and manufacturing equipment. Technical experts from the various areas collaborated from the start. The goal was to create a device that was functional and appealing to the consumer, but could be manufactured in a way to significantly drive down cost.

Adhesive and Material Development

A big challenge was formulating a skin-friendly adhesive for the patch-based wearable sensor that met several key requirements: The adhesive had to be gentle, yet strong, to minimize the potential for discomfort or irritation upon removal, but ensure user confidence and quality of life during wear. It had to perform, staying in place during daily activities. To meet these requirements, Avery Dennison Medical Solutions custom-designed a new skin-friendly adhesive formulation.

A foam substrate carries the adhesive and provides a waterproof enclosure for the device's electronics—battery, ASIC and memory, and ECG. In addition to its

sophisticated design and functionality, the patch-based wearable sensor has a low profile and can be worn comfortably and inconspicuously.

Designing the Manufacturing Platform

As product development activities proceeded, manufacturing experts at Avery Dennison Medical Solutions consulted with team members involved in design, adhesives, electronics and materials. It was critical that the device under development could be mass produced.

The team has designed and is currently testing an integrated roll-to-roll manufacturing and packaging system that handles and assembles the various components of the device in sequence in line-to-line fashion. A special press completes the manufacturing process by enclosing the components in an integrated module and then automatically packaging the assembled product.

Future Applications

The first patch-based wearable sensor is scheduled to launch with BodyMedia in late 2012. Avery Dennison Medical Solutions and its business partners envision additional consumer applications, as well as potential clinical applications. They are committed to pursuing opportunities for new wearable sensor technologies in the mobile health sector, which industry experts forecast will exceed $2 billion by 2015.

Deepak Prakash *[1] is the Global Market Segment Manager at Avery Dennison Medical Solutions.*

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[1] mailto:Deepak.Prakash@averydennison.com