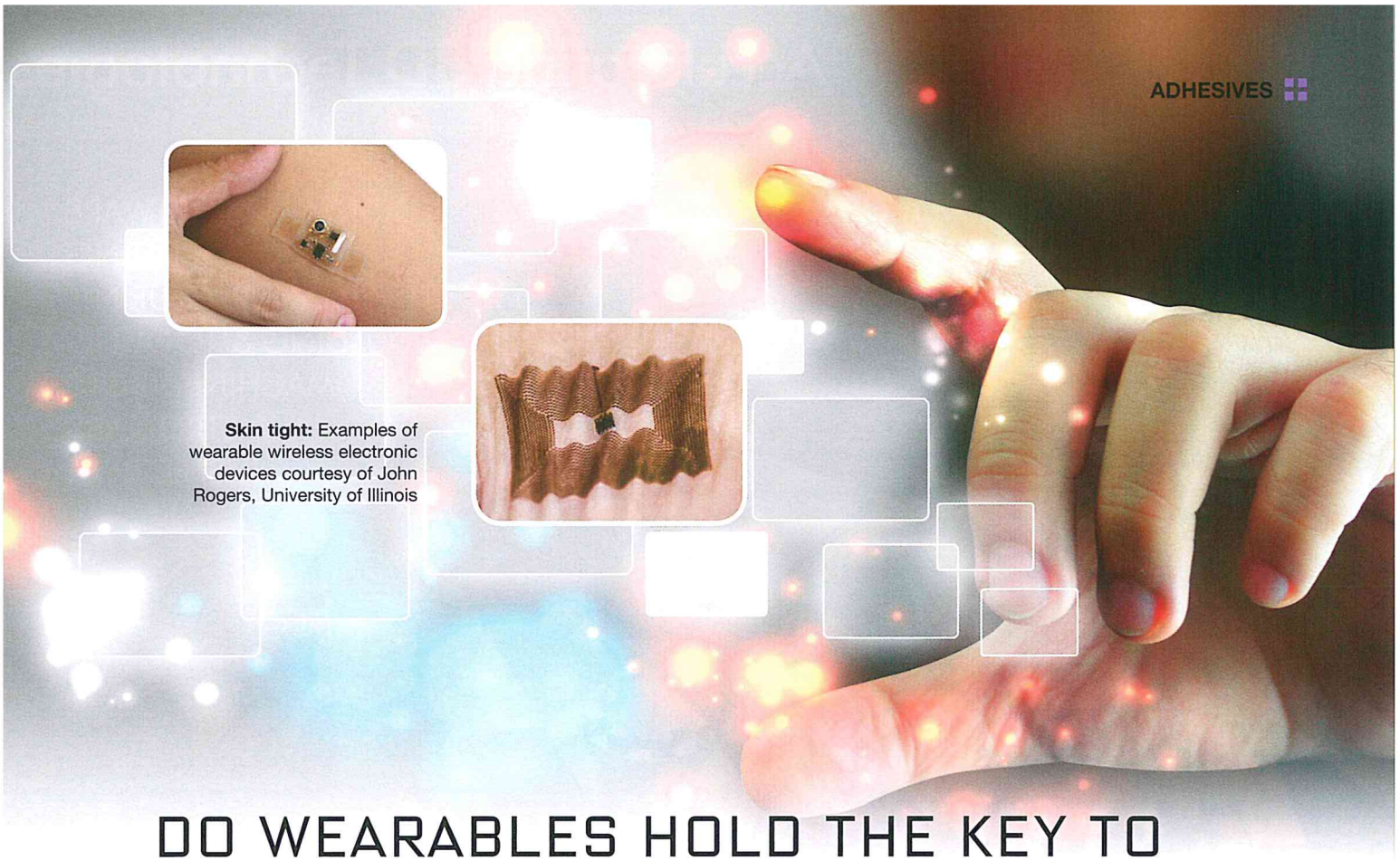

Skin tight: Examples of wearable wireless electronic devices courtesy of John Rogers, University of Illinois

DO WEARABLES HOLD THE KEY TO THE ADHESIVES MARKET?

Adhesives are critical components in the design and manufacture of the majority of medical devices. As medical devices become smaller and more complex, greater demands are being made on the materials and components used in them. Even more exciting are estimates that only about one-half of the applications that could be served by adhesives are actually using adhesives in assembly, leaving significant growth opportunity. The global medical adhesive market is projected to reach $10,015.67 million by 2019, growing at a CAGR of 9.65% between 2014 and 2019. (MarketsandMarkets Research Report May 2015). However, some of this growth will result from improved processing methods and technology and not just new adhesive advancements. Application and curing equipment play a critical role in the design and manufacture of these devices.

Techsil looks at the future for medical device adhesives and the growing importance that the wearable market holds

Wearable market interest

UK-based adhesive distributor Techsil is often offered a glimpse into the future via the enquiries it receives from design engineers working in the research and development stage of future products.

Sales director, Chris Dilley comments: "The last few years has seen us working with design engineers from the automotive sector developing adhesives for driverless braking and steering technology in cars which are now a reality and expected to be on our roads by 2025.

"If we focus our crystal ball on the medical market and look at the trends for the next five to ten years we are receiving an increasing number of enquiries from design engineers involved in the research and development of wearable medical devices that will not come to market until 2020 or after; indicating that this is a fast growing market. We are seeing new product development and technical advances every day."

> Research says by 2018, the market size for wearable medical devices is estimated to reach $12 billion

This is backed up by the latest research which says by 2018, the market size for wearable medical devices is estimated to reach $12 billion, increasing 6.5 times compared to today.

Dilley adds: "I see a future where electronics are part of our clothes and wearable diagnostic technology will become ubiquitous. For example someone with diabetes might look at their shirt cuff and an electronic sensor will measure insulin levels and remind the reader to take it. Or an electronic badge incorporated to your overalls that will flash if you go into a gaseous area and are at risk of falling unconscious."

Some of the latest wearable medical device designs include – emergency call buttons, smart clothing that measures vital outputs and wearable sensors that monitor individual's outputs and wirelessly transmit the data to health professionals. The developing technology of E-textiles, based on electrically-active woven fibres, used in smart apparel, bandages and bed linen will be able to sense and emit light, heat, cool, change shape, compute and wirelessly communicate, sometimes even

diagnose and treat medical conditions! This offers huge opportunities in the merging healthcare, medical, fitness and wellness sector.

As the adhesives industry responds to the challenges of this market, new advances are widening the performance envelope for medical adhesives. Variations in polymer compositions, coupled with compounding differences, are allowing properties to be tailored to meet specific application requirements, including:

- *Bio-stability*
- *Flexibility for comfort*
- *Electrically conductive*
- *Sterilisation resistant*
- *Snap cure with light*
- *Solvent free*
- *Thermal stability*
- *Easily automated*

Techsil recently introduced a new jettable conductive adhesive to the UK market from adhesive manufacturers Panacol.

According to Dilley: "Jet dispense compatibility and snap cure make these conductive adhesives an ideal choice for high speed production of wearable electronics. Conductive adhesives are used for bonding electronic components onto flexible substrates that ordinary metal solder would melt. And the adhesive is more comfortable next to skin than solder."

Other advances in medical devices that are designed to operate on a patient's skin or even inside the patient's body, present medical adhesive manufacturers with probably the toughest challenges yet where the adhesive may need to be:

- *Biocompatibility and non-toxic*
- *Able to adapt to moisture changes in skin to offer extended wear time*
- *Handle fluids, adhere to wet surfaces, be breathable and/or absorbent*
- *Flexible to bond to movable areas such as elbow or knee joints*
- *Contain embedded chemicals for transdermal delivery*
- *Easily removable*
- *Be transparent*
- *To dissolve*

New adhesive formulations are being discovered all the time – many inspired by 'sticky things' found in nature. In August 2015 a 'gecko-inspired' adhesive went into mass production.

In November 2015 researchers at MIT announced the development of a new synthetic hydrogel superglue which mimics the way mussels and barnacles tightly glue themselves to ship hulls or whales. The transparent, rubber-like adhesive is 90% water and its bonding toughness is orders of magnitude higher than any previous hydrogel glue. As the hydrogel is biocompatible, it may also be suitable for a range of health-related applications, such as biomedical coatings for catheters and sensors implanted in the body.

Similarly researchers at UC Santa Barbara have designed an adhesive also based on mussels which forms atomically smooth, ultra thin glue layers which hold particular promise for the fabrication of nano-scale electronic devices, including circuits and battery components.

We keenly watch this space for the next exciting adhesives that might come to market following these new discoveries and other like them.

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>
> **Chris Dilley**
> **sales director, Techsil**