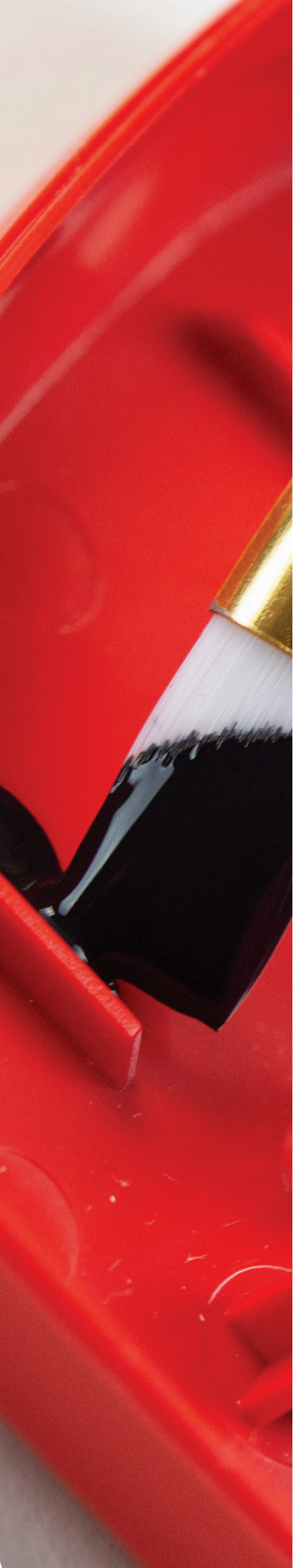

MASTERBOND®
CASE STUDY

EP75-1: Electrically conductive adhesive for a sensor in a biomarker detector

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EP75-1: Electrically conductive adhesive for a sensor in a biomarker detector

Overview of EP75-1

Master Bond EP75-1 is a two-component, graphite-filled, electrically-conductive (volume resistivity of 50–100 Ω·cm) epoxy adhesive that is ideal for bonding, sealing, and coating applications. It contains no solvents, meets ASTM E-595 low outgassing specifications, and bonds well to a wide variety of substrates including metals, composites, and plastics. Since it is filled with graphite, it is electrically conductive without using a metallic filler like silver.

Application

Paper-based sensors have various applications, including wearable sensors and biosensors, and are often lower-cost alternatives to traditional semiconductor sensors. A team of researchers at SUNY Binghamton and SUNY Stony Brook developed a nanoparticle-sensitized printed flexible chemiresistor sensor on paper for detecting chemical species to provide an alternative to traditional sensors that use rigid semiconductor substrates. As part of their proposed design to integrate the paper sensor into an HPM (human performance monitor), the authors proposed the use of EP75-1 as a robust, non-toxic adhesive with suitable electrical conductivity.

Key Parameters and Requirements

The contacts on the sensor side of the HPM (human performance monitor) needed to be connected to the paper sensor using a conductive adhesive to provide both mechanical and electrical contact between the two components. As the paper sensor would need to contact human skin, the authors required a conductive adhesive that was nontoxic. The authors searched for an adhesive with a non-metallic conductive filler and chose Master Bond EP75-1, a graphite-filled epoxy adhesive. Although EP75-1 is not as conductive as metal-based adhesives, it is still more conductive (volume resistivity of 50–100 Ω·cm) than carbon inks used to print electrodes. It can also be cured at a lower temperature to avoid damaging the HPM and sensor materials, such as "a few hours" at 65–95°C after drying overnight at room temperature.

Results

The authors fabricated paper-based devices for the chemiresistor based sensing of different volatile organic compounds (VOCs), including several alcohols and organic solvents. Compared with a polyimide device used as the control, the paper-based device showed a greater sensitivity to VOCs. The authors also measured acetone (a biomarker for diabetes) using the paper-based sensor sensitized with a gold nanoparticle thin film, demonstrating its promising applications for monitoring acetone in the breath of diabetes patients. These initial results suggested that the paper-based sensor could be integrated with an HPM by connecting it to existing thermistor circuitry, as shown by the red box in ***Figure 1***. The authors then discussed which materials and techniques would be needed to accomplish this.

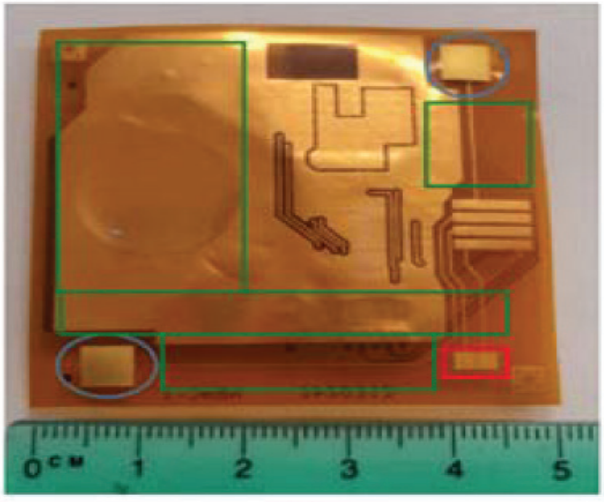

Figure 1. Proposed integrated HPM. The red box indicates the location of a thermistor, which would be replaced by the printed sensor developed by the authors and adhered using EP75-1. The use of EP75-1 would provide robust mechanical and electrical contact between the HPM and the paper-based monitor.

As part of their proposed design for the flexible wearable sensor, the contacts located on the sensor side of the HPM would be connected to the paper-based sensor using a conductive adhesive to provide both mechanical and electrical contact between the two. This would ensure that the paper sensor would be in conformal contact with the body, identical to the designed thermistor (***Figure 1***, red box). In this way, sweat and/or vapors exuded from the skin can be measured by the sensor.

The Role of EP75-1: A Non-toxic, Electrically Conductive Adhesive

The authors required a non-toxic and robust adhesive. EP75-1 is an ideal alternative when a non-metallic electrically conductive adhesive is required and was selected by the authors because it has a suitable electrical conductivity and can be cured at temperatures that will not damage the HPM or sensor materials.

This case study demonstrated the feasibility of using a paper-based monitor for manufacturing wearable HPMs, particularly those that can detect specific VOC biomarkers such as acetone. As part of the proposed design, EP75-1 can be used to provide robust, electrically conductive contact between the sensor and HPM to create flexible wearable electronics patches that can monitor important biomarkers such as acetone.

References

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