Process Development for Integrating Electronics in Textiles

M. Lützelschwab, S. Widmer, P. Glocker, A. Steinecker

CSEM developed a process which facilitates the insertion of electronic devices into textiles. The goal was to fabricate a demonstrator featuring a curtain, which incorporates an "EXIT" sign consisting of 400 LEDs. The exit sign should be hardly recognizable when switched off but should light up brightly in case of an emergency. This EU-Project was generally aiming to explore options for industrialized embedding of electronics into textiles, opening up a wide range of completely new applications.

The integration of rigid electronic devices into flexible uneven structures is a non-trivial task for the assembly process, particularly if several components have to be placed in close proximity and in considerable quantities. An interdisciplinary team was involved, including specialists in robotics as well as packaging. This report focuses on the packaging part.

Figure 1 shows the main achievement, which is the "EXIT" sign demonstrator, comprising about 400 LEDs inside a curtain showing an emergency case with the lights being switched on.

Figure 1: 400 assembled LED's showing EXIT sign.

The features of the LED device are of the same magnitude as the textiles features, thereby making the assembly process more challenging. Figure 2 gives an impression about the dimension of the LED device with respect to the textile and its conductive tracks seen from the backside.

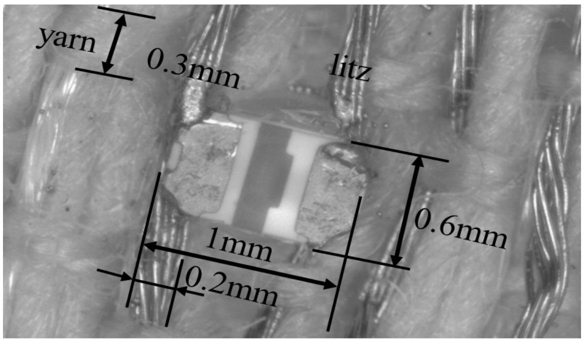

Figure 2: Image of an assembled LED.

The LED device is held by a tungsten vacuum gripper during the insertion process. Its fixation and proper guidance strongly depends on the momentum that is exerted during the insertion process on the LED device having a pyramidal mount. This means that the shape of the pyramid plays a crucial role on the insertion yield. Several iteration steps by the LED device's manufacturer[1] were required to find the ideal shape to achieve the anticipated yield.

Figure 3 shows an overview of the assembly process.

The left hand side (1) shows an LED with a glued polymer pyramid. This device is integrated into the textile that is depicted below which features a Cu litz on its surface. The LED device is then inserted into the textile and soldered to the Cu litz to establish electrical and mechanical contact (2). In a last step the tip of the pyramid is molten and flattened to further enhance the mechanical connection between textile and LED device as well as improving the optical output.

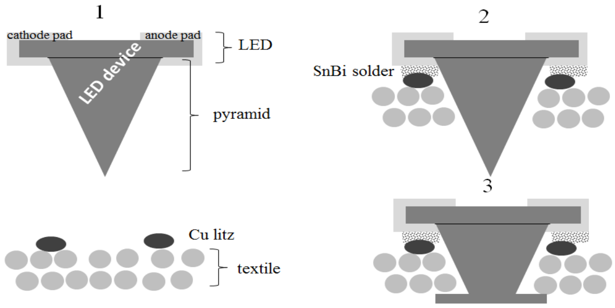

Figure 3: Illustration of the bonding principle.

Different melting and glass transition temperatures of the materials play an important role for the process development. Figure 4 shows the different values. Due to this, the process times and conductivity of the different parts and interfaces needed to be well investigated to keep the LED device intact and to ensure no detrimental effects appear on the textile.

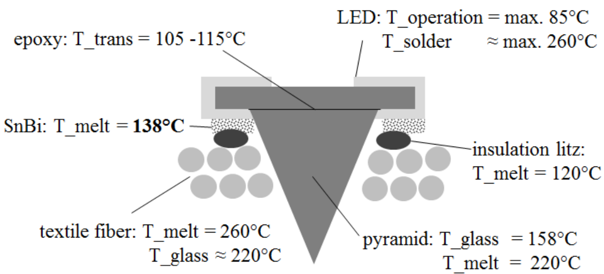

Figure 4: Melting and glass transition temperature for the different components of the LED device and textile.

Several demonstrators were fabricated with a placement yield better than 95%. Good results concerning reliability were obtained.

The research leading to these results has received funding from the European Union Seventh Framework Program FP7/2007-2011 under grant agreement n° 258724.

[1] PEP, Centre Technique de la plasturgie et des Composites, Bellignat, France