# Fabrication of Conformal Electronics Packaging with Microfluidic Eutectic Metal Interconnects

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## Abstract

In the design of modern robots, the ability to negotiate unstructured environments while not damaging or being damaged by its surroundings is an important consideration. Some such applications range from disaster relief, search and rescue, structure inspection, surveillance and medical diagnostics; to physical therapy and human machine interaction. In order to make robots much more approachable, and less likely to damage their environment, one approach is to build the robots using soft and flexible materials [1, 2]. The development of soft robots is constrained by the inclusion of electronic circuits. Traditional rigid printed circuit boards add stiffness when the desire is flexibility and polyimide flex circuits are not extensible when the desire is to compress and stretch the robot. A circuit that conforms and stretches in the same manner as the soft robot body is needed. In response, we have developed a method of manufacturing electronics packaging for off-the-shelf components (e.g. surface mount devices or SMD) using room temperature liquid eutectic gallium-indium (eGaIn) interconnects and cast silicone encapsulation. The process includes standard SU-8 lithography for making a micro-mold where the SMD components are placed and encapsulated with polydimethylsiloxane (PDMS). Consideration of forming 3D micro-channels, adhesion between SMD packages and PDMS, release from the mold, sealing of the micro-channels and evacuating the air so the channels can be filled, created a reliable electronics package for the use in soft robots.

[1] S. Kim, C. Laschi, and B. Trimmer, "Soft robotics: a bioinspired evolution in robotics," *Trends in biotechnology,* vol. 31, pp. 287-294, 2013.

[2] B. A. Trimmer, H.-T. Lin, A. Baryshyan, G. G. Leisk, and D. L. Kaplan, "Towards a biomorphic soft robot: design constraints and solutions," in *2012 4th IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob)*, 2012, pp. 599-605.