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Fabrication of Fixed-Shape Soft Smart Objects by Thermoplastic Forming of Flat Stretchable Circuits

Andres Vasquez Quintero ¹, Jan Vanfleteren ¹, Frederick Bossuyt ¹, Bart Plovie ¹, Rik Verplancke ¹, Herbert De Smet ¹

¹, imec Ghent University, Gent-Zwijnaarde Belgium

Hide Abstract

There is a growing interest in soft smart structures with embedded sensors and electronics. Although mechanically soft and easily deformable, in some applications these objects should take a predetermined shape when no other external forces than gravity are acting on them. Examples of such objects are smart lenses or smart shoe insoles. In this contribution we will present technologies for the production of such fixed-shape soft smart objects. A stretchable sensor and electronics circuit is first produced on a flat carrier using conventional thin-film or PCB (printed circuit board) technology, also including the assembly of the components. Fabrication on flat carriers makes these technologies suitable for future transfer to an industrial environment. The circuit is subsequently embedded in one or more thermoplastic polymers, and the obtained flat circuit is finally formed from flat to its final 3D shape using a thermoforming step. The stretchability of the electrical connections between components guarantees maintained functionality of the circuit after deformation. Using this technology principle smart lenses were built with embedded active (Si chip) and passive (antenna) components. The contribution will describe in further detail the technologies used, the smart lens electrical and mechanical design flow, as well as the characteristics of the obtained smart lenses.