

Mechanical Characterization of Fully Flexible Polyimide Membrane-Substrate Integration

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In the context of air flow sensing on non-planar surfaces, membrane-based differential pressure sensors integrated in flexible substrate can offer new possibilities for simplifying the hardware around sensors and breaking the installation costs. Polyimide-based membranes in a polyimide substrate are one of the paths to develop flexible differential pressure sensors compatible with large area structures. This work proposes in depth mechanical analysis on both flat and non-flat support plates, in order to characterize the impact of the substrate's flexibility on the membrane.

First, the deflection measurement of flexible membranes is carried out by White Light Interferometry (WLI) using a Polytec MSA500, equipped with a custom pressure chamber driven by an Hallstrup KAL 100 to control pressure. WLI is also used to quantify the impact of non-flat support plates, bending the substrate and inducing pre-deflection strain in the membrane. Second, characterization of the mechanical transient response to pressure onset and dynamic response can happen. The instrumentation for non-static measures in the present setup combines Laser Doppler Vibrometry (LDV) and camera-based in plane analysis on the same Polytec MSA500.

Through deflection characterization, the quality of a fabrication process can be assessed regarding residual stresses and initial buckling. The rigidity of the membrane material can also be extracted, leading to Young's modulus estimations, providing further information on fabrication. Quantifying the impact of substrate bending is key for applications on non-flat surfaces, as it might influence mechanical sensitivity, range and other Figures of Merit of a future sensor.

Bio

Eléonore Masarweh was born in Belgium in 1997. She completed a Master in Electromechanical Engineering Specialized in Mechatronics at UCLouvain, Belgium, in 2021 with a Master Thesis about MEMS membrane mechanical aspects. She pursues research as a PhD candidate at UCLouvain in the fields of MEMS, membrane-based pressure sensors and flexible electronics.