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Piezoelectric flexible tactile sensor based on poly-silicon TFT for humanoid robotsL. Maiolo^{1,2}, A. Pecora¹, F. Maita¹, A. Minotti¹, G. Fortunato¹, D. Ricci² and G. Metta²¹IMM-CNR, Via del Fosso del Cavaliere 100, 00133 - Roma (Italy),²RBCS, Istituto Italiano di Tecnologia, Via Morego 30, 16163 – Genova (Italy)E-mail: luca.maiolo@iit.it

The interaction of humanoid robots with different and complex environments demands the implementation of sophisticated sensory capabilities. In particular, the development of tactile sensors is one of the key technical challenges in advanced robotics [1]. Today, touch sensing technology has improved and many new touch sensors have been presented, using different materials and transduction methods [2,3]. However, most of these devices are still big in size and are made on rigid substrates, so they cannot be applied to high sensors density areas such as robot fingertips. For this reason, we propose a new fabrication process for the integration of a piezoelectric flexible capacitor based on PVDF-TrFE with a low temperature polysilicon thin film transistor (LTFS TFT) on a polyimide (PI) support, exploiting an extended gate configuration (Fig.1). Such a device can be fabricated on PI spun on a rigid carrier and then it can be mechanically detached, obtaining touch sensors on highly flexible substrates (PI is about 10 μm thick) [4]. In order to obtain a piezoelectric response, the PVDF-TrFE capacitor is poled at a temperature of 80 $^{\circ}\text{C}$, by applying an electric field of about 80 V/ μm . For this device, we used TFTs with $W/L=40$, mobility of 40 cm^2/Vs and an on-off ratio of about 10^6 . The tactile sensor was then connected to an external load of 2.7 $\text{k}\Omega$ in a source-follower floating gate arrangement, in order to preliminarily test the electromechanical response to a specific stimulus, showing a piezoelectric coefficient of about 25 pC/N (Fig.2) and an output signal of 0.5 mV/N to a normal force stimulus at 1Hz (Fig.3).

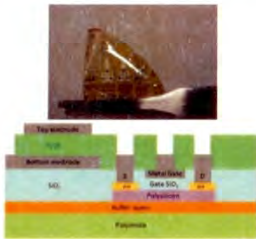


Fig.1 A photograph of a flexible tactile sensor and a cross-section of the device

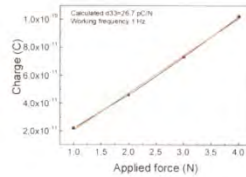


Fig. 2 Piezoelectric capacitance linear response for increasing applied forces.

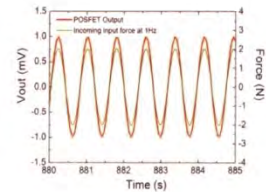


Fig. 3 Flexible sensor response for a sinusoidal signal of an amplitude of 4 N, at a frequency of 1 Hz

References

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