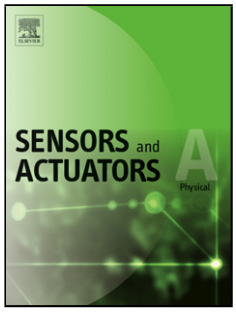

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Investigation of tactile bump array actuated with ionic polymer–metal composite cantilever beams for refreshable braille display application

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- Digitally controllable tactile bump array for a refreshable braille display usage.
- The bump array driven with IPMC actuators through unique wire-pair selection.
- Complete device was thinner than 2 mm constructed with four functional layers.
- The soft bump can be lifted to give varied pressure experiences on the fingertip.
- Novel in-situ characterization of the Young's modulus of IPMC beam is developed.

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ABSTRACT

This paper presents an innovative digitally controllable tactile bump array driven with ionic polymer–metal composite (IPMC) actuators for a refreshable braille display application. The array with 5 × 5 PDMS bump elements was implemented in front of the IPMC cantilever beams as the contact interfaces of fingertips and IPMC actuators. The designed circuit allows to access every single element through unique wire-pair selection so that the actuated electrical signal could directly apply to both electrodes of the IPMC cantilever beam. A soft and thin PDMS layer was realized underneath the IPMC cantilever beams to maintain the level while the IPMC actuators loaded with the bumps in the non-actuation state and to minimize the liquid evaporation containing in the IPMC actuator. The fabricated actuator array is qualitatively tested to ensure that the fingertip can properly feel the force variation when the bump is driven by the IPMC actuator. The displacements of the bumps with different weights under the same driving condition of the IPMC actuators is also measured. A novel method of using the experimental results for in-situ characterization of the Young's modulus of the IPMC cantilever beam during its operation is developed. This scheme can be employed in the situation in which the cantilever beam is subjected to an unknown external force during its partial motion cycle. The results show that a maximum moment variation of 1.6 μN·m can be generated for the fabricated 3 mm × 0.8 mm × 0.2 mm IPMC cantilever beam under an 8-V square wave actuation for 1 s. The maximum blocked forces at the bump surfaces reach 0.68 mN and 0.55 mN for the bumps of masses 4.1 mg and 15.5 mg, respectively.