# Large-area Pulsed Laser Deposition and Assembly Processes for Piezoelectric MEMS Devices Based on All-oxide LaNiO3/Pb(Zr,Ti)O3/LaNiO3 Thin-films

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This research presents the fabrication of all-oxide $LaNiO_3/Pb(Zr,Ti)O_3/LaNiO_3$ thin films for applications in piezoelectric microelectromechanical systems (piezoMEMS). All oxide layers are fabricated on 4-inch silicon-on-insulator (SOI) wafer using large-area pulsed laser deposition (PLD) by SolMateS B.V. The determined film-thickness variation is less than 5% over the total wafer area. PZT thin-film of 1-µm-thick exhibits (100) texture orientation.

The optimization of the electromechanical responses for piezoelectric membranes is investigated experimentally. In the optimization of membrane- and electrode-geometries, $Pb(Zr,Ti)O_3$ (PZT) actuators consisting of a variety of membrane type, membrane diameter and electrode coverage are fabricated using microfabrication processes and characterized by laser Doppler interferometer for piezoelectric responses, like displacement and resonance frequency.

The fabricated 500-µm-diameter PZT membrane provides high central displacement of 26 nm/V at a constant frequency well below its first resonance frequency ($f_r$ = 330 kHz). The results also indicated that the membrane diameter has a dominant effect on the magnitude of the out-of-plane displacement and the resonance frequency. The electrode-size to membrane-diameter ratio or electrode coverage is important and may be tailored to optimize the displacement. Electrode coverage of 36% produces the optimum displacement. Moreover, it shows an excellent long-term stability of membrane actuators with a displacement remains of about 95% after 10 billion actuations, by using the conductive-oxide $LaNiO_3$ (LNO) layers as the electrodes.