# The role of epitaxy in microelectromechanical systems made with transition metal oxide films

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I review some of our recent results in the field of *oxide nanomechanics*, where the peculiar physical properties of selected complex oxides – such as the occurrence of structural or magnetic phase transitions - are exploited through epitaxy for the realization of thin film microactuators and mechanical resonators for sensing applications. The deposition substrate and its crystallographic orientation are two important parameters for the operations of our mechanical devices that are based on suspended thin film elements realized by removing portions of the substrate using wet etchants. The substrate crystallographic orientation influences the structural properties of the films and the fabrication process of the final device geometry. Furthermore, the stress produced by heteroepitaxial growth tunes the three-dimensional profile and the mechanical resonances of the devices. Examples of microelectromechanical systems made with (La,Sr)$MnO_3$ and $VO_2$ thin films are discussed.

**References**

[1] Manca N., Remaggi F., Plaza A. E., Varbaro L., Bernini C., Pellegrino L., and Marré D. Stress Analysis and Q-Factor of Free-Standing (La,Sr)MnO3 Oxide Resonators. Small 2022; 18(35):2202768. doi.org/10.1002/smll.202202768
[2] Plaza AE, Manca N, Bernini C, Marré D, Pellegrino L. The role of etching anisotropy in the fabrication of freestanding oxide microstructures on SrTiO3 (100), SrTiO3 (110), and SrTiO3 (111) substrates. Appl Phys Lett. 2021;119(3):033504. doi:10.1063/5.0056524
[3] Manca N, Kanki T, Endo F, Ragucci E, Pellegrino L, Marré D. Anisotropic Temperature-Driven Strain Dynamics in VO2 Solid-State Microactuators. ACS Appl Electron Mater. 2021;3(1):211-218. doi:10.1021/acsaelm.0c00776
[4] Manca N, Kanki T, Endo F, Marré D, Pellegrino L. Planar Nanoactuators Based on VO2 Phase Transition. Nano Lett. 2020;20(10):7251-7256. doi:10.1021/acs.nanolett.0c02638

Related projects: www.vo2actuators.spin.cnr.it and www.oxinems.eu, the OXiNEMS project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 828784.