Highlights

Oxides —2017

Selective High Frequency Mechanical Actuation Driven by the VO_2 Electronic Instability

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Advanced Materials, 29(35), 1701618 (2017)

Relaxation oscillators consist of periodic variations of a physical quantity triggered by a static excitation. They are a typical consequence of non-linear dynamics and can be observed in a variety of systems. VO_2 is a correlated oxide with a solid-state phase transition above room temperature, where both electrical resistance and lattice parameters undergo a drastic change in a narrow temperature range. This strong non-linear response allows to realize spontaneous electrical oscillations in the MHz range under a DC voltage bias. These electrical oscillations are employed to set into mechanical resonance a microstructure without the need of any active electronics, with small power consumption and with the possibility to selectively excite specific flexural modes by tuning the value of the DC electrical bias in a range of few hundreds of millivolts. This actuation methods is robust and flexible and can be implemented in a variety of autonomous DC-powered devices. (Copyright Wiley-VCH Verlag GmbH & Co. KGaA. Reproduced with permission.)

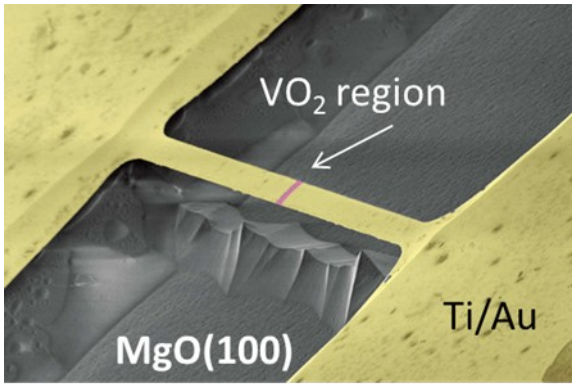

Fig.1: False-colored scanning electron microscopy picture of a microbridge. Electrical current is injected by the gold pads (yellow) into the VO_2 region (magenta). The phase transition is triggered by the temperature increase due to Joule effect.

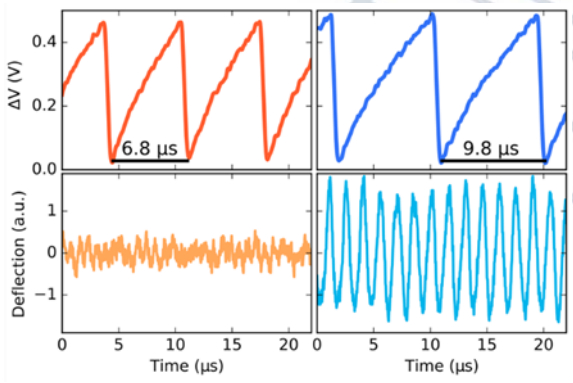

Fig.2: Time plots of the voltage drop across the microbridge and its mechanical deflection. By tuning the DC voltage bias, the frequency of the electro-thermal oscillations changes and can trigger the mechanical excitation of the structure. This occurs when the frequency of one of the harmonic components of the electrical oscillation matches one of the flexural modes of the microbridge.