Dynamics of MoS_2 Resonator in presence of Intermodal Coupling through Internal Resonance

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Abstract

Modal interaction in coupled systems is of immense interest due to its promising potential to enhance performance of resonators[1] and oscillators[2]. We investigate the effect of intermodal coupling through internal resonance on the dynamics of MoS_2 resonator. The scanning electron micrograph of MoS_2 resonator is shown in Figure 1. Vibrational modes of two-dimensional resonators are inherently coupled through the tension in the membrane[3]. The coupling and energy exchange between the modes is further enhanced when the vibrational modes are commensurate leading to internal resonance[3]. We observe peak splitting a signature of energy exchange through internal resonance in MoS_2 resonators. Peak splitting is observed even when the device is not strongly driven into the nonlinear regime. We further model our device response as a coupled system using numerical integration scheme. The simulations enabled to qualitatively understand the effect of excitation force, frequency detuning and modal coupling strength. Figure 2 shows the simulated response of the coupled fundamental mode on increasing the excitation force. The dynamical characteristics studied in the present work can be potentially used to improve the performance of two-dimensional resonators through internal resonance.

References

[1] Zhang et al, JMEMS 25, 937-946 (2016)
[2] D. Antonio *et al,* Nat. Commun. 3, 806 (2012)
[3] C. Samanta *et al*, Appl. Phys. Lett. 107, 173110 (2015)

Figures

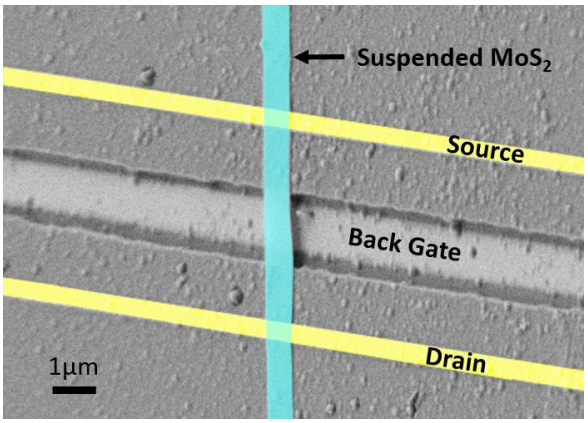

Figure 1: False colored scanning electron micrograph (SEM) of MoS_2 resonator.

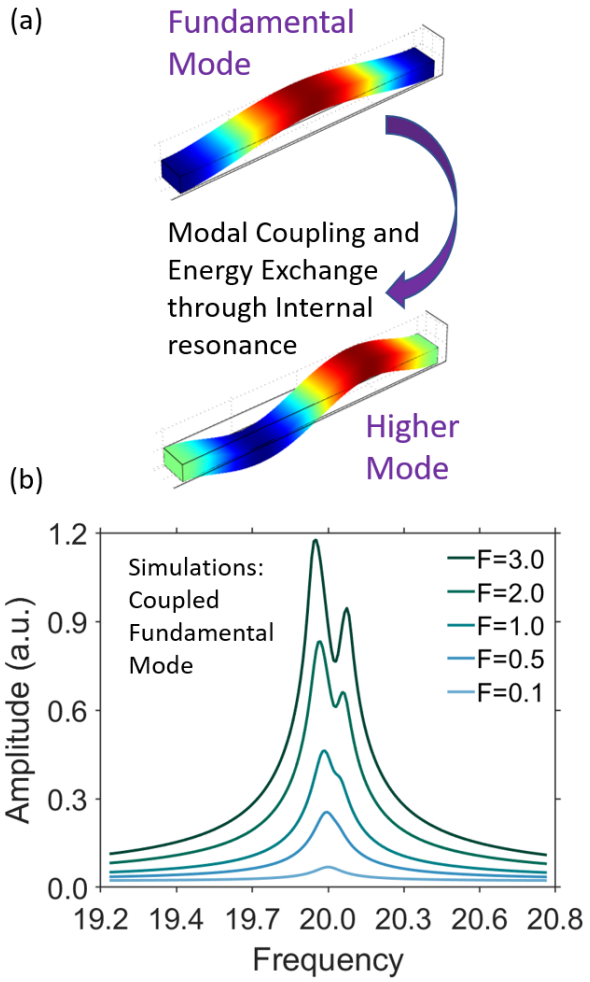

Figure 2: Simulated response of fundamental vibrational mode with increasing actuating force in presence of intermodal coupling through internal resonance.