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Photothermal Effect and Heat Dissipation in a Micromechanical Resonator

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We describe the photothermal effect in an aluminium–silicon nitride doubly-clamped beam with an optical deflection scheme. Incident optical power results in the temperature rise in the composite beam and the shift in the resonance frequency due to thermal stress. The observed dynamic response is consistent with the detailed beam equation as well as the thermal conduction model. The pressure-dependent dynamics of the beam allows the investigation of convective heat dissipation due to the surrounding gas molecules as well as determination of heat transfer coefficient. The photothermally coupled operation presented here opens up the prospects for miniaturized pressure-sensing elements.