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Slot-mode optomechanical crystals with enhanced coupling and multimode functionality¹ KAREN GRUTTER, MARCELO DAVANCO, KARTIK SRINIVASAN, NIST - Natl Inst of Stds Tech — A number of cavity optomechanics applications involve multiple interacting optical and mechanical modes. A key challenge in such systems is developing multimode platforms with both flexibility in the optical and mechanical designs and interactions as strong as those shown in single-mode systems. We thus present slot-mode optomechanical crystals, in which photonic and phononic crystal nanobeams separated by a narrow slot couple optomechanically. We pattern these beams to confine a low-loss optical mode in the slot and a mechanical breathing mode at the center of the mechanical beam. This structure has large optomechanical coupling rates and great design flexibility toward multimode systems. We demonstrate this in Si_3N_4 slot-mode devices, with 980 nm optical modes coupling to mechanical modes at 3.4 GHz, 1.8 GHz, and 400 MHz. We use Si_3N_4 tensile stress to shrink slot widths to 24 nm, greatly enhancing optomechanical coupling. Finally, with this platform, we develop multimode systems with three-beam geometries, in which two different mechanical modes couple to one optical mode and two different optical modes couple to one mechanical mode.

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