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Piezo-optomechanical circuits KRISHNA COIMBATORE BALRAM[1], MARCELO DAVANCO, B. ROBERT ILIC, KARTIK SRINIVASAN, NIST - Natl Inst of Stds Tech — Coherent links between the optical, radio frequency (RF), and mechanical domains are critical for applications ranging from quantum state transfer between the RF and optical domains to signal processing in the acoustic domain for microwave photonics. We develop such a piezo optomechanical circuit platform in GaAs, in which localized and interacting 1550 nm photons and 2.4 GHz phonons are combined with photonic and phononic waveguides. GaAs allows us to exploit the photoelastic effect to engineer cavities with strong optomechanical coupling ($g_0/2\pi \approx 1.1$ MHz) and the piezoelectric effect to couple RF fields to mechanical motion through surface acoustic waves, which are routed on-chip using phononic crystal waveguides. This platform enables optical readout of electrically-injected mechanical states with an average coherent intracavity phonon number as small as ≈ 0.05 and the ability to drive mechanical motion with equal facility through either the optical or electrical channel. This is used to demonstrate a novel acoustic wave interference effect in which optically-driven motion is completely cancelled by electrically-driven motion, and vice versa. As an application of this, we present time-domain measurements of optically-controlled acoustic pulse propagation.

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