

# Optical and mechanical design of a “zipper” photonic crystal optomechanical cavity

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**Abstract:** Design of a doubly-clamped beam structure capable of localizing mechanical and optical energy at the nanoscale is presented. The optical design is based upon photonic crystal concepts in which patterning of a nanoscale-cross-section beam can result in strong optical localization to an effective optical mode volume of 0.2 cubic wavelengths  $((\lambda_c)^3)$ . By placing two identical nanobeams within the near field of each other, strong optomechanical coupling can be realized for differential motion between the beams. Current designs for thin film silicon nitride beams at a wavelength of  $\lambda = 1.5 \mu\text{m}$  indicate that such structures can simultaneously realize an optical  $Q$ -factor of  $7 \times 10^6$ , motional mass  $m_u \sim 40$  picograms, mechanical mode frequency  $\Omega_M/2\pi \sim 170$  MHz, and an optomechanical coupling factor ( $g_{\text{OM}} \equiv d\omega_c/dx = \omega_c/L_{\text{OM}}$ ) with effective length  $L_{\text{OM}} \sim \lambda = 1.5 \mu\text{m}$ .

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