Silicon Nitride ($\text{Si}_3\text{N}_4$) membranes show an extraordinary mechanical quality factor ($>10^9$) due to dilution dissipation occurring when a tensile stress is applied.

$$Q_{\text{mat}} = \frac{f_m}{f_m} = \frac{\text{stored}}{\text{dissipated}} = Q_{\text{total}}D Q(\sigma)$$

Attractive platform for fabricating high precision micromechanical resonators

Novel concept for thermometry with optical read-out

Anchor losses one of the main limits of the current $\text{Si}_3\text{N}_4$ micromechanical generation

Engineered structure to strongly localize acoustic waves and enhance quality factor

Periodic variation of masses opens a bandgap = frequency range where acoustic waves cannot travel

Periodicity disrupted by a ‘defect’ to form localized resonances

Fabrication of ultra-high aspect ratio (>30,000:1) $\text{Si}_3\text{N}_4$ microstructures

2D $\text{Si}_3\text{N}_4$ membrane hexagonal periodicity
Pre-stress: 1.3GPa

thickness: 35 nm
xy dimensions: 3 mm

1um holes: release from the top photonic crystal

Large mass
80 um

Small mass
5 um

Experimental Results. Microscopic vibrations isolation