1. MODAL CHARACTERISTICS OF DEVICES

Numerical simulations, based on the Finite Elements Method (FEM), were performed during the device design step to assure that:

* the Si device layer is thin enough to not guide slab modes,
* the loading Si₃N₄ strip has a maximum size to support only one single Transverse Electrically (TM) polarized optical mode.

The first condition is satisfied when the effective refractive index $n_{eff}$ of the Si slab mode becomes smaller than the refractive index of the bottom SiO₂ cladding, $n_{cladd}$, below a certain thickness $h_{slab}$ for a given wavelength (set to $\lambda = 1550$ nm in our case). The considered geometry in this case comprises a slab of Si with a top air cladding and a bottom SiO₂ cladding. The result of these simulations is shown in Fig. S1(a).

For the second condition, the exact geometry, shown in Fig. 1(a) of the main manuscript, was considered. In this case, the height of the LPCVD Si₃N₄ strip was fixed to 145 nm, which is the maximum allowed thickness for the deposition of this material (thicker layers might crack due to excessive tensile stress). In addition, the Si slab thickness was set to 27 nm according to results for slab simulations. Then, the effective mode index was simulated against the width $w$ of the Si₃N₄ strip. The single-mode condition was set for the width below which the higher-order modes were leaking into the silica cladding, as shown in Fig. S1(b).

![Graph](image1.png)

**Fig. S1.** (a) The effective refractive index of the guided mode in the Si device layer as a function of slab thickness. (b) The effective refractive index of the strip-loaded TE1 (continuous blue) and the TE2 (dash-dot, green) as a function of the strip width and the wavelength. Below $w \approx 1.3 \mu$m the waveguide supports only one single TE mode.
Table S1. Modal characteristics

| $\lambda$ (µm) | $n_{eff}$ | $\Gamma$ (Si) | $\Gamma$ (Si$_3$N$_4$) | $\Gamma$ (SiO$_2$) | $\Gamma$ (air) |
|----------------|-----------|--------------|----------------------|-------------------|--------------|
| 1.54           | 1.5920    | 30.9         | 34.3                 | 30.2              | 4.5          |
| 1.55           | 1.5886    | 30.7         | 34.1                 | 30.5              | 4.6          |
| 1.56           | 1.5852    | 30.5         | 33.9                 | 30.9              | 4.7          |

Based on the simulations, the effective indices of modes, the modal confinement factors $\Gamma$ (in %) in different layers were calculated. The results are summarized in Table S1.

The effective mode area $A_{eff}$ for the considered wavelengths was evaluated from the integral

$$A_{eff} = \frac{\left[ \int \int |E(x,y) \times H^*(x,y)| \cdot |z| \, dx \, dy \right]^2}{\int \int |E(x,y) \times H^*(x,y)|^2 \, dx \, dy}$$

and is 0.688, 0.7 and 0.713 µm$^2$, respectively.

2. ANALYSIS OF EXPERIMENTAL SPECTRA OF THE RING RESONATORS

In this section, a generic procedure of analysis of the experimental spectra is described. After acquiring the experimental transmission spectra the raw data are processed in the following order using an in-house developed Matlab code:

1. a search routine determines the spectral positions $\lambda_0$ of all clear resonances,

2. the spectrum is normalized to the background using the Fabry-Pérot (FP) fringes due to the waveguide’s facets reflections. This is done by skipping a set of datapoints within predefined spectral windows close to each individual resonance such to avoid deforming the Lorentzian lineshapes after normalization,

3. the normalized spectrum is fitted automatically around each resonance using a Lorentzian fit and considering simultaneously the background FP fringes of the bare waveguide’s spectrum,

4. from fit results a set of parameters, such as the resonance linewidth, the total, intrinsic and coupling Q-factors as well as the modes free-spectral range, FSR, are extracted,

5. the group index of the modes is calculated via $n_g = \lambda_0^2 / (FSR \times L)$, where $L$ is the resonator round trip length,

6. finally, the loss value in units of cm$^{-1}$ is extracted using the relation $\alpha = 2\pi n_g / (Q \times \lambda)$.

As an example, we show in Fig. S2(a) the normalized transmission spectrum of the waveguide, which is almost critically coupled to a 60 µm radius and 1300 nm wide resonator through an 800 nm gap. A zoom of the spectrum around a resonance at 1546.8 nm is shown in Fig. S2(b) together with the fitting curve. This procedure is performed automatically inside a loop for all available resonances within the wide spectrum, and the extracted parameters are stored in a datasheet.

The extracted FSR and the calculated group index of resonator’s modes for the shown example are plotted in Fig. S3(a) and Fig. S3(b), respectively.

Finally, the described procedure has been applied for all UV-untreated and UV-exposed devices, permitting to acquire necessary data and enough statistics.

Fig. S2. (a) An example of a background-normalized spectrum of a UV-untreated ring resonator (the radius is 60 µm, the Si$_3$N$_4$ strip width is 1300 nm and the coupling gap is 800 nm. The spectrum shows a large number of close-to-critically coupled resonances of a single TE1 family of radial modes. (b) A blow-up of a resonance around $\lambda$ = 1546.8 nm (red, dots) is plotted together with the fitted curve (black line).

Fig. S3. (a) The free-spectral range and (b) the group index of the resonator modes are plotted after the analysis of the transmission spectrum shown in Fig. S2.

REFERENCES

1. Y. Zhang, S. Qiao, L. Sun, Q. W. Shi, W. Huang, L. Li, and Z. Yang, "Photoinduced active terahertz metamaterials with nanostructured vanadium dioxide film deposited by sol-gel method," Opt. Express 22, 11070-11078 (2014).