



Fig. 4. Thermal optical bistability near the molecular vibration peak (a) Output power of pump and probe versus input pump power. The pump is 3.06 (red) to mode resonant at 1540.065 nm and the probes are set at 2.81 (light blue), 2.87 (navy), and 2.93 (black) to the mode resonant at 1542.962 nm Inset: The probe laser detuning to the resonance versus the pump power dropped into the resonator, driving the resonance to the correspondent probe laser wavelength. (b) Time domain self-heating dynamics to the step function input. The laser intensity step-function turns on to 1 mW. The laser-cavity detunings are -2 pm (blue) and 2 pm (red) respectively. The dots are experimental data and the lines are the exponential curve fitting. The lifetime is about 150 μ s for both cases. Inset: Thermal switching dynamics for negative laser-cavity detuning (blue arrow) and positive detuning (red arrow), as the cold cavity resonance (solid grey line) red-shifted by thermal heating (dashed grey line).

6. Conclusions

The wavelength selective molecular absorption modifies the linear absorption of the PECVD silicon nitride ring resonators, and led to thermal bistability. The absence of free carrier dispersion could improve the stability of thermal bistable switching. Three independent models are compared to experimental data for correlating the linear loss in waveguide to microring resonator behavior. With fixed scattering loss, higher linear loss from material absorption steepens the extinction ratio in the overcoupling region, and enhances the empirical quality factor of the resonator. The phonon absorption, coupled with enhanced Q factors, leads to pico joule level bistable switching in the wide bandgap material based microring resonator. The power dependent nonlinear transmission spectrum is numerically described by the couple mode theory.

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