$10\log_{10}(P_{max}/P_{min})$ increases with increasing RF power and DC voltage and is a maximum of 6dB at 15V DC bias and 5dBm RF power. The amplitude of optical modulation for a given radial displacement is obtained by numerically solving the dynamical equation for the optical energy within the optical resonator [2,24]. The calibrated values of radial displacement from these numerical simulations are shown as the alternate y axis on the transmission spectrum of Fig. 3c and Fig. 4. A larger modulation depth can be obtained for the same power and bias voltages by increasing the mechanical quality factor of the disks, which are currently limited by the anchor loss. As there is only one layer to fabricate the resonators and the electrical routing beams, the disk is electrically grounded by a beam that is connected to its edge. This beam is at the maximum displacement point of the radial mode of the disk increasing anchor loss leading to a lower Q_{mech}.

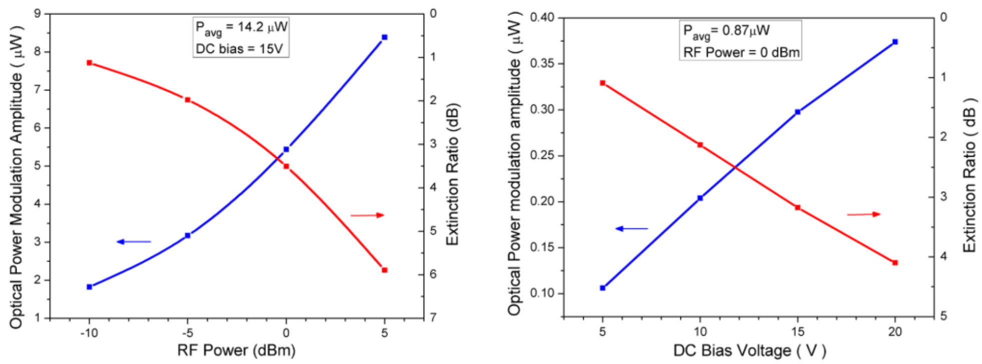

Fig. 5. Variation of the amplitude of optical power modulation and extinction ratio with RF power (left) and DC bias voltage (right) for an optical input power of 6dBm(left) and −6dBm(right).

5. Summary

We have demonstrated a monolithic electrically actuated silicon optomechanical resonator operating at a frequency of 235MHz. There is no DC power dissipated in this device as the DC bias is applied across a capacitor. Since the optical response to the electrical input is shaped by the mechanical transfer function, the device is similar to a RF filter in series with an optical modulator. This device can provide a low-power, on-chip modulator for enabling narrow band applications such as a chip scale implementation of an Optoelectronic Oscillator [25,26]. In its application as narrowband modulator, the device presented in this work can overcome inefficiencies associated with the repeated conversion from electrical → acoustic-filter → electrical → impedance-match → electrical → optical by directly going from electrical → acoustic-filter → optical. This device offers an additional input for controlling the state of an optomechanical system and can be applied in interesting applications of optomechanics such as cooling of mechanical modes [18], in laser locking [27] and RF photonics [28].

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