It should be possible to realize this scheme in a tapered nano fiber (TNF) set-up, yielding an efficient modulator at the telecom wavelength at very low control powers. The TNF will be designed to operate as a single mode fiber for all three wavelengths: 780 nm, 795 nm and 1323 nm. We have carried out designs of such a TNF, and have shown that there is a range of taper diameters for which it is possible to have a significant overlap between the evanescent modes at these three wavelengths. The TNF would be embedded in a Rb vapor cell, of the type reported in [7], and pressurized with a ^{4}He buffer gas at ~3 atm. The pump and the auxiliary beams will be orthogonally polarized, and combined with a polarizing beam splitter. The probe will be combined with these beams using a dichroic mirror. The combined beams will be launched into the TNF. Similar techniques will be used to separate the probe from the other beams at the output. Of course, the intensity needed to saturate a 500 GHz broadening would be too hard to realize in a TNF. However, based on a typical DPAL laser employing Rb, which requires a threshold pump intensity of about 15 $\mu W/\mu m^2$, we estimate that a pump power of about 3 μW should be enough to achieve a few GHz modulation bandwidth in the TNF, which has a mode area of only 0.2 μm^2.

7. Conclusion

We have demonstrated a high-efficiency optical modulator at ~1323 nm using the quantum Zeno effect in a ladder transition in a Rb vapor cell. We observe cross-modulation of the signal beam transmission as the control beam is intensity modulated. We obtain a 3dB bandwidth of approximately 5 MHz, which can be improved to a few GHz by using buffer gas to enhance the homogenous broadening. The bandwidth can be controlled by the relaxation rates between the $5P_{1/2}$ and $5P_{3/2}$ states, which in turn are controlled by the buffer gas pressure. It should be possible to realize this scheme in a tapered nano fiber set-up, yielding an efficient modulator at the telecom wavelength at very low control powers.

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