the chamber for ten minutes before measurement is taken. This is to ensure that the temperature in the membrane and the chamber is stabilized for maximum accuracy.

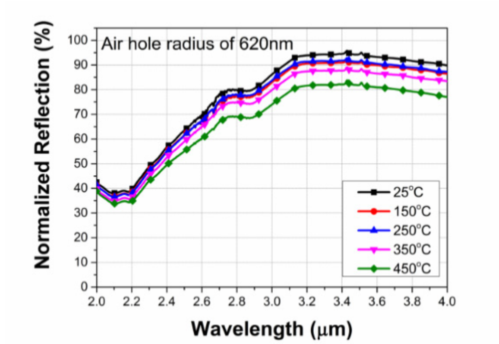

Fig. 4. Measurement of the AlN based PhC of air hole radius of 620nm under various temperatures.

The measurement of the AlN based PhC with air hole radius of 620nm under various temperature conditions are shown in Fig. 4. At room temperature (25°C), the peak reflection wavelength of the AlN based PhC with air hole radius of 620nm is around 3.29μm. As the temperature increases, based on Eq. (1), the refractive index of AlN also increases. This raises the effective refractive index and induces a redshift in the peak reflection wavelength. At 450°C, the peak reflection wavelength of the AlN based PhC is around 3.31μm, with a 14.1nm redshift in wavelength. With n_0 and λ_0 being 2.2 and 3.29μm respectively, the thermo-optic coefficient is estimated to be 2.22×10^{-5} K^{-1}, which is an order of magnitude lower than Si [20]. This proves to be extremely important for the use of AlN based PhC in applications such as the mirrors in Fabry-Perot interferometer working in harsh environments. Even at elevated temperatures, the low thermo-optic coefficient of AlN ensures that the peak reflection wavelength does not change drastically. This minimizes degradation in performance of the Fabry-Perot interferometer in term of its quality factor and its transmitted output wavelength, hence enhancing its robustness in various applications.

3. Conclusion

In conclusion, an AlN based PhC is fabricated and characterized as a highly reflective mirror working in the MIR wavelengths. The AlN slab is designed to be 330nm thick and the air hole radius is varied from 600nm to 640nm. Through measurement, the PhC with air hole radius of 620nm is shown to have greater than 90% reflection across 3.08μm to 3.78μm, with the peak reflection of 96% at 3.16μm. Characterization of the AlN based PhC is also performed at 450°C to examine the thermo-optic effect. Due to the minute increase in the refractive index of AlN at elevated temperatures, it is measured that the peak reflection redshift by 14.1nm when the temperature is at 450°C. The thermo-optic coefficient is estimated as 2.22×10^{-5} K^{-1}. This is an order of magnitude lower than Si and is hence significantly better performing in high operating temperatures. This highlights the suitability of using AlN over Si as a photonic material especially when the applications involve high temperature fluctuation such as Fabry-Perot interferometer for gas sensing applications in down-hole oil drilling and ruggedized electronics.

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