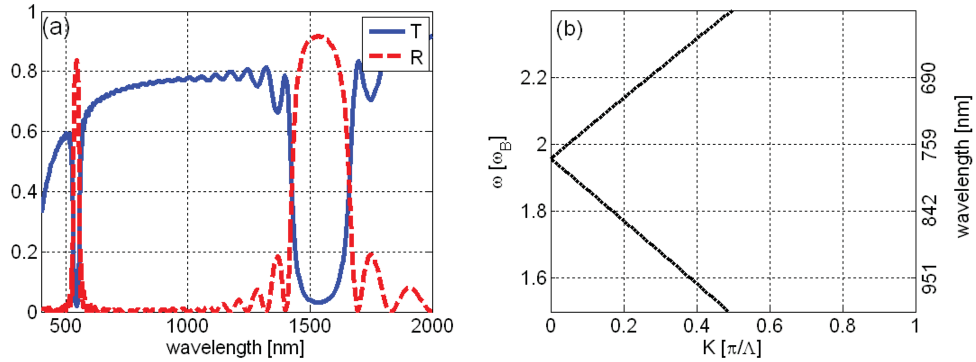

Fig. 10. (a) Reflection (R) and transmission (T) spectra and (b) Bloch diagram for the MIM WBG with the filling factor of 0.548

6. Conclusion

In this paper, we revealed that the high order plasmonic Bragg reflection takes places in the MIM WBG and presented a method to find the high order plasmonic Bragg wavelength based on the graphical method. Unlike the high order Bragg wavelengths in the case of the conventional DSW, they exhibited red shifts of $14\,nm$ and $31\,nm$ from the result of non-dispersive assumption for the second and the third order plasmonic Bragg wavelengths, respectively. This was also verified with the reflection and the transmission spectra from the RCWA and the Bloch diagram from the Bloch wave analysis. As applications using the high order plasmonic Bragg reflection, we suggested the MIM WBG at the visible spectral regime without gratings of not too short period, which had the third order stop band at the wavelength of $532\,nm$ with the grating period of $492\,nm$. We also proposed the MIM WBG with a narrow reflection band at the telecommunication wavelength ($1550\,nm$) with the bandwidth of $61\,nm$, which was comparable with the MIM WBG with the low index contrast and the short period ($60\,nm$). Finally the dependence of the filling factor upon the bandgap was addressed and the quarter-wave stack condition and the second bandgap closing were discussed.

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