with

$$\kappa = \frac{\mu_z\beta - \mu_{yz}k_y}{\mu_y\mu_z - \mu_{yz}^2}. \tag{40}$$

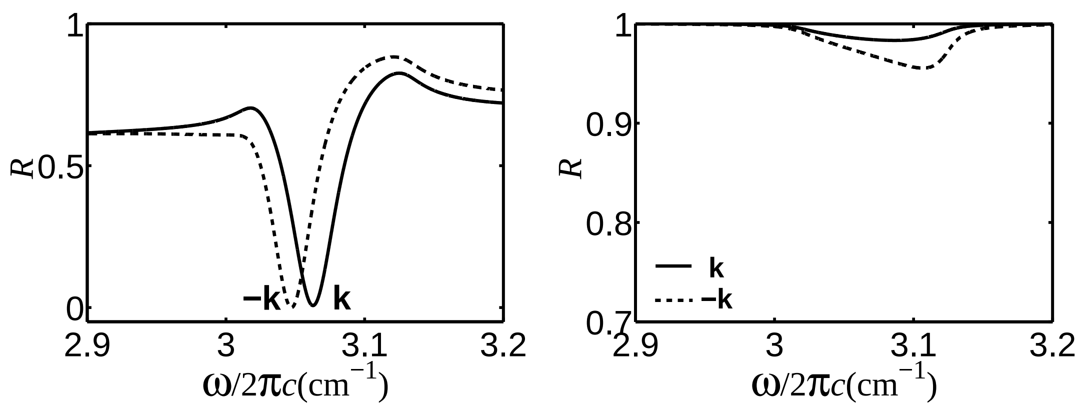
Here, the wave-vector

$$k_y = (\epsilon_p)^{1/2}\frac{\omega}{c}\sin\theta \tag{41}$$

and

$$k_z = (\epsilon_p)^{1/2}\frac{\omega}{c}\cos\theta \tag{42}$$

represents propagation along and normal to the surface, where ϵ_p is the prism dielectric constant, and θ is the incident angle.



(a)ATR spectra at 30^o. (b)ATR spectra at 70^o.

FIG. 3. ATR spectra with incident angles 30^o and 70^o. In (a) two different sharp dips illustrate the non-reciprocity of the surface modes. In (b) the absence of the sharp dips indicate the absence of surface modes.

Calculated ATR results for the $BaMnF_4$ is presented in Fig. 3(a) and 3(b) for the incident angles 30^o and 70^o. The ATR spectra at 30^o illustrates nicely the nonreciprocity of surface modes. Two sharp dips correspond to surface polaritons traveling in the opposite directions and the frequencies are the ω_m intersection points discussed above for the positive and negative surface mode branches. The ATR for an incident angle of 70^o, shown in Fig.3(b) does not allow coupling to surface modes. The shallow dips represent bulk modes.

It is interesting to notice that the surface modes do not exist in the region where the wave-vector $k \gg \frac{\omega}{c}$. In this region, the surface dispersion relation in Eq. (31) can be re-written in the form

$$\mu_y\mu_z - (\mu_{yz} \mp 1)^2 = 0 \tag{43}$$