chemicals are applied to the device. The spectra in Fig. 6(b) are measured by the CCD and normalized to the spectrum of incident broadband light source. The vertical axis in Fig. 6(b) has an arbitrary unit. It can be seen that the resonance wavelengths in the first order diffraction are slightly blue-shifted from the resonance peak wavelengths in the zeroth order transmission. When chemicals are applied to the device surface, the peak diffraction wavelengths in the first order diffraction are shifted. Tracking the shift of the diffraction peak wavelength of the longer wavelength resonance, it is found that the first order diffraction peak wavelength shifts from 778 nm in the air to 794 nm in the methanol, and again shifts to 809 nm in the IPA. By calculating the sensitivity based on the first order diffraction peak wavelength shift from the methanol to the IPA, the sensitivity for index of refraction is 319 nm/RIU.

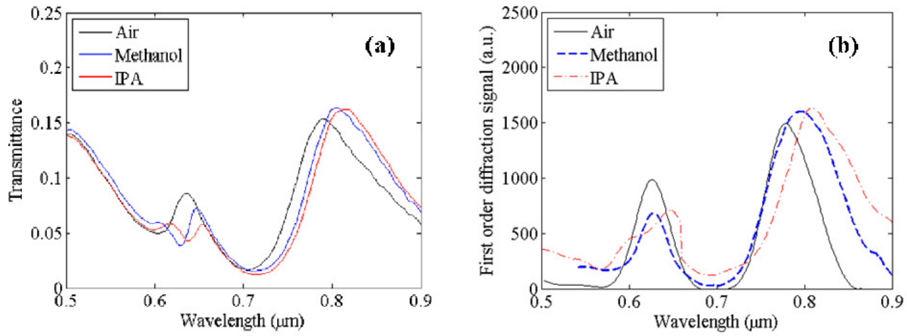

Fig. 6. Measured surface plasmon resonance spectra when different liquid chemicals are applied to the super-period gold nanohole array surface: (a) the zeroth order transmission spectra measured by using a commercial spectrometer and (b) the first order diffraction spectra obtained by using our integrated surface plasmon resonance spectrometer.

4. Summary

Surface plasmon resonance in super-period metal nanohole arrays are investigated by calculating resonance spectra of the zeroth order transmission, the first order diffraction, and the near field resonance. It is found that the first order diffraction resonance peak wavelength is slightly blue-shifted from the zeroth order transmission peak wavelength. It is also found that the first order diffraction peak wavelength is approximately the same as the near field resonance wavelength although near field resonance wavelength slightly varies with the location of measurements. An integrated surface plasmon resonance spectrometer based on an e-beam lithography patterned super-period metal nanohole array is experimentally demonstrated. The surface plasmon resonance spectrometer can measure surface plasmon resonance from the spatially dispersed first order diffraction with a single shot CCD data image capture. The integrated surface plasmon resonance spectrometer based on the super-period metal nanohole array performs the functions of surface plasmon resonance sensing and resonance spectral measurements simultaneously.

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