이중 필터링을 통한 음향광학변조필터의 분광 분해능 향상에 대한 연구

Spectral resolution enhancement and sidelobe compression of acousto-optic tunable filter (AOTF) by doulbe filtering technique

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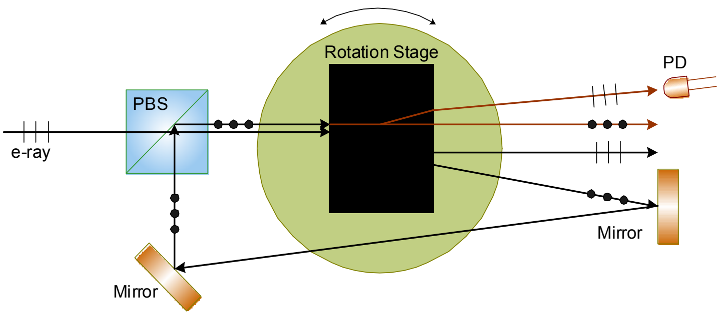
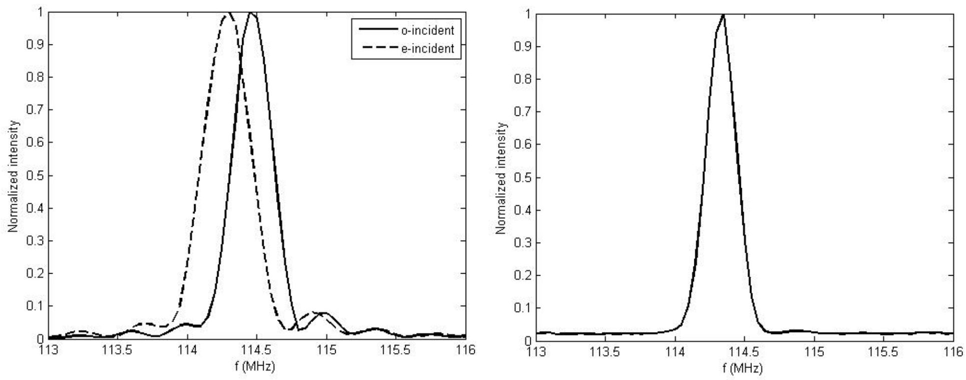
Promising features of the acousto-optic tunable filter (AOTF), such as fast wavelength scanning, relatively high spectral resolution, compact size, and rigid structure, make it popular for wavelength selecting and the scanning of broadband light sources. There are two kinds of AOTF, collinear and non-collinear. Non-collinear AOTF is more popular in the spectral imaging analysis because of its wide incident angle based on the parallel tangent condition which was proposed by I.C.Chang.[1, 2] From the design procedure and previous experimental data of AOTF, we found that the spectral resolution of filtered light from AOTF cannot be changed after the AOTF is fabricated, even if the spectral bandwidth can be designed high enough. (1~3 nm) Also, spectral sidelobes always exist in the spectrum of filtered light originatedfrom acousto-optic interaction inside the crystal (typically TeO_2), which lowers the sensitivity of the spectrum.[3] Attempts have been made to reduce these sidelobes, using either collinear hardware scheme[4] or a software method[5]. In this letter, we propose a new scheme to obtain higher spectral resolution and sidelobe compression for non-collinear AOTF. In this paper, we review the design principle of the AOTF focusing on the effect of the incidence angular variation. Incidence angle is adjusted to fulfill the initial condition of partial spectrum folding before applying the proposed double filtering technique. And finally the experimental results – higher spectral resolution and suppressed spectral sidelobes – are provided.

The two diffracted light from AOTF can be spectrally folded by rotating AOTF to change incidence angle. We propose double filtering technique to increase spectral resolution and suppress spectral sidelobes inherited from AOTF. The incidence angle needs to be adjusted by rotating the AOTF near the crossing point to fold the spectrum of each diffracted light with two photodiodes. Once the angle is found then the proposed schematic setup is constructed as shown in figure below. Polarized light passing through the polarizing beam splitter (PBS) enters the AOTF as an extra-ordinary light. The AOTF generates ordinary diffracted light from this extraordinary incident light. The diffracted light from the AOTF crystal is separated from undiffracted light with ~5° downward and reflected by two mirrors to return to the PBS. The polarization state of the diffracted light is 90 shifted from the incident light by the AOTF. So, at this time, PBS reflects this ordinary diffracted light to reenter the AOTF. Finally the AOTF generates extraordinary diffracted light from this reentered ordinary light. The final light departs upward from the AOTF so that there is no need to separate it from other light which makes the system simple. This double filtering is efficient (low loss) with a PBS because of the unique characteristic of AOTF which filters specific wavelength λ and changes the polarization state.



After the incidence angle is adjusted near the crossing point so that two diffracted spectrums are folding (left figure), system is modified following the schematic setup described above. The spectrum of finally diffracted light is in right figure below. Through the double filtering technique, the spectral resolution is enhanced and sidelobes inherited from the AOTF are diminished.



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