



# Bilayer Polarization Gratings for Polarization Independent Tunable Optical Filters



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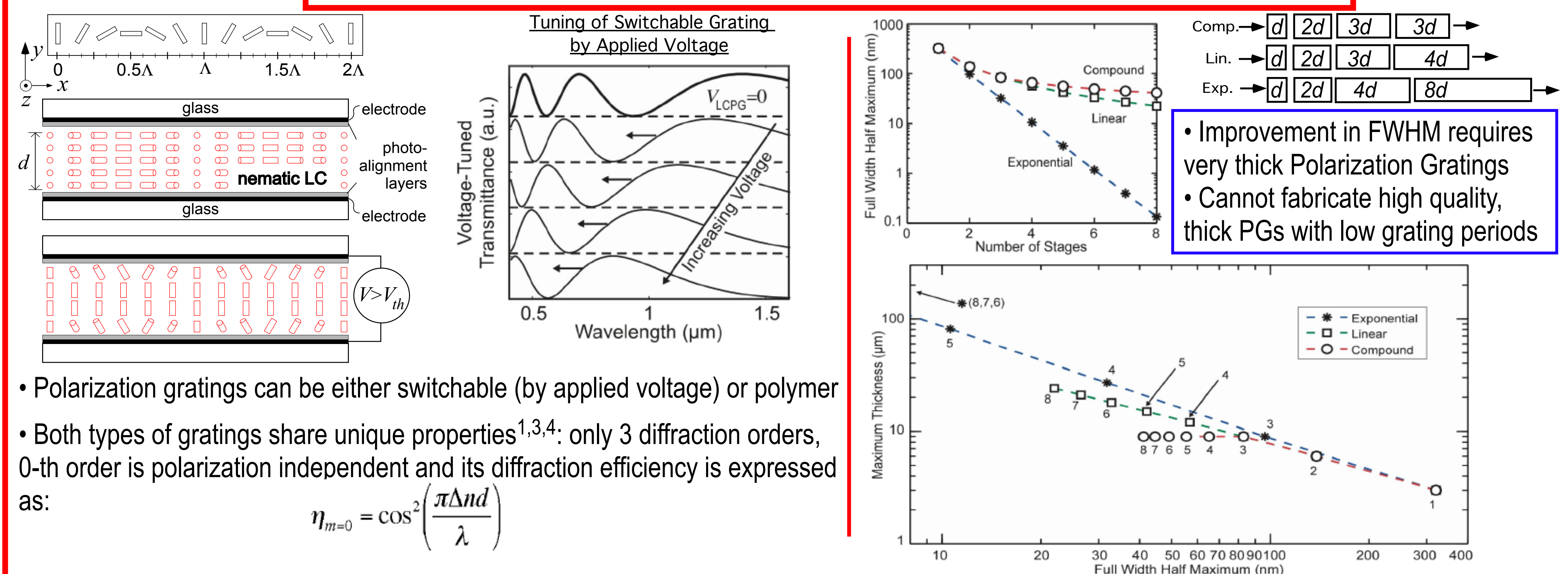
Optoelectronics and Lightwave Engineering Group

Electrical & Computer Engineering

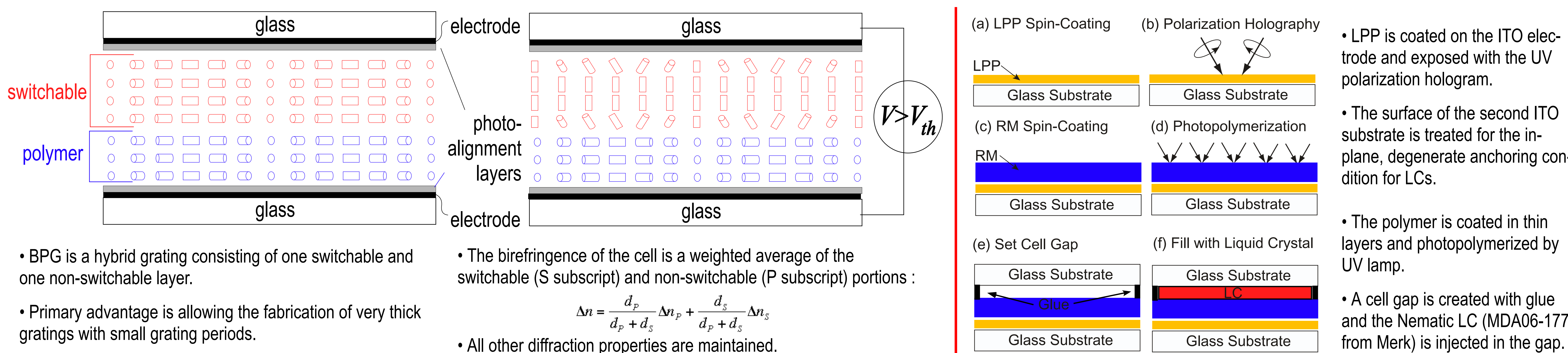
## Summary & Motivation

- We introduce a **Bilayer Polarization Grating** which enables more effective implementation of highly compact tunable passband filters with small bandwidth and polarization independence<sup>1</sup>.
- The key advantage of the BPG is that it allows very thick tunable gratings to be implemented with small grating periods.
- The BPG tunable optical filter has several important applications including ultra-compact imaging spectroscopy, medical imaging, and remote sensing.<sup>2</sup>
- In this work we discuss the fabrication techniques and compelling properties of BPGs. We also evaluate the advantages of these gratings for the tunable optical filter application.

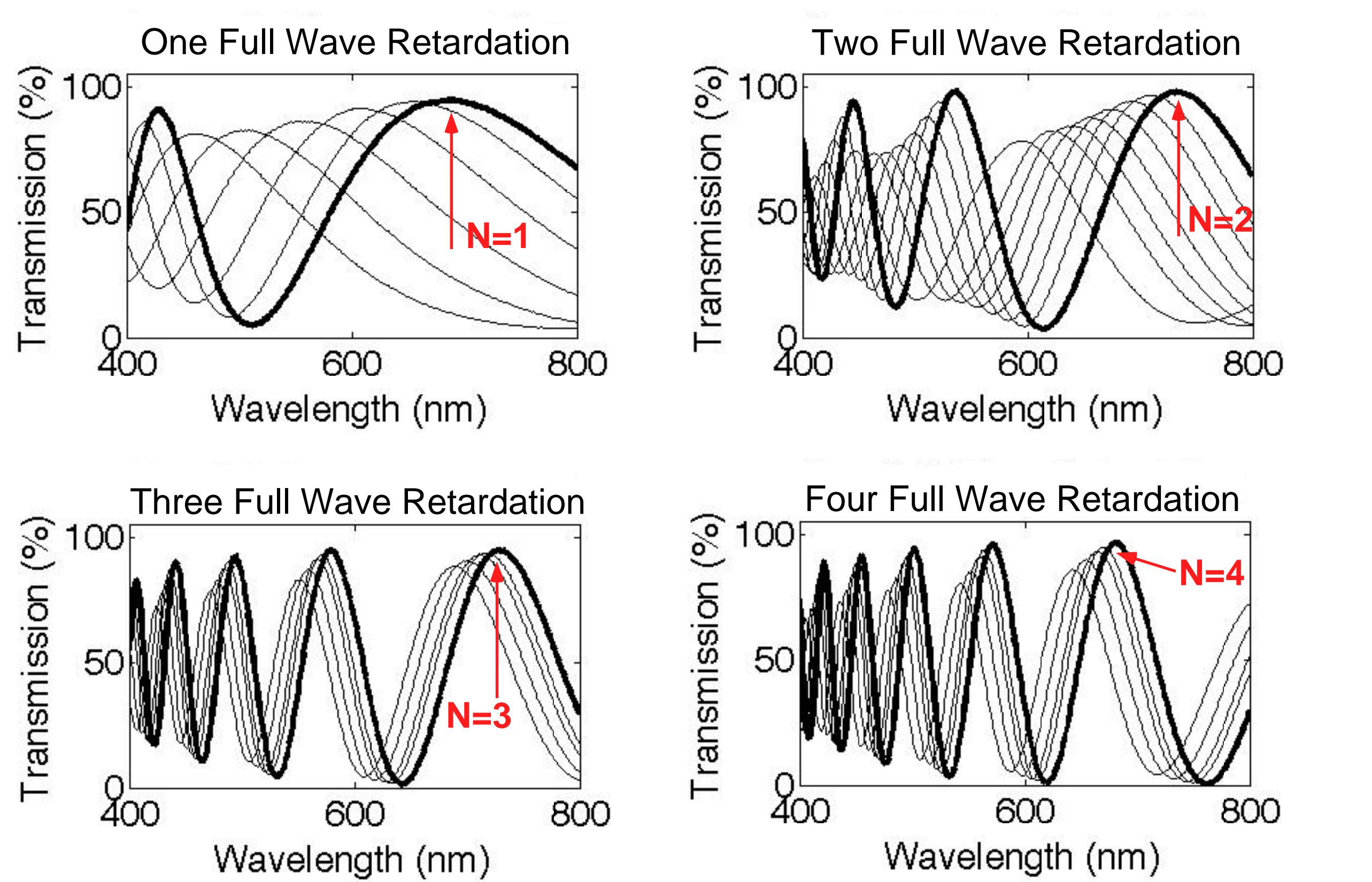
## Polarization Gratings as Tunable Optical Filters



## Bilayer Polarization Grating - Theory and Fabrication

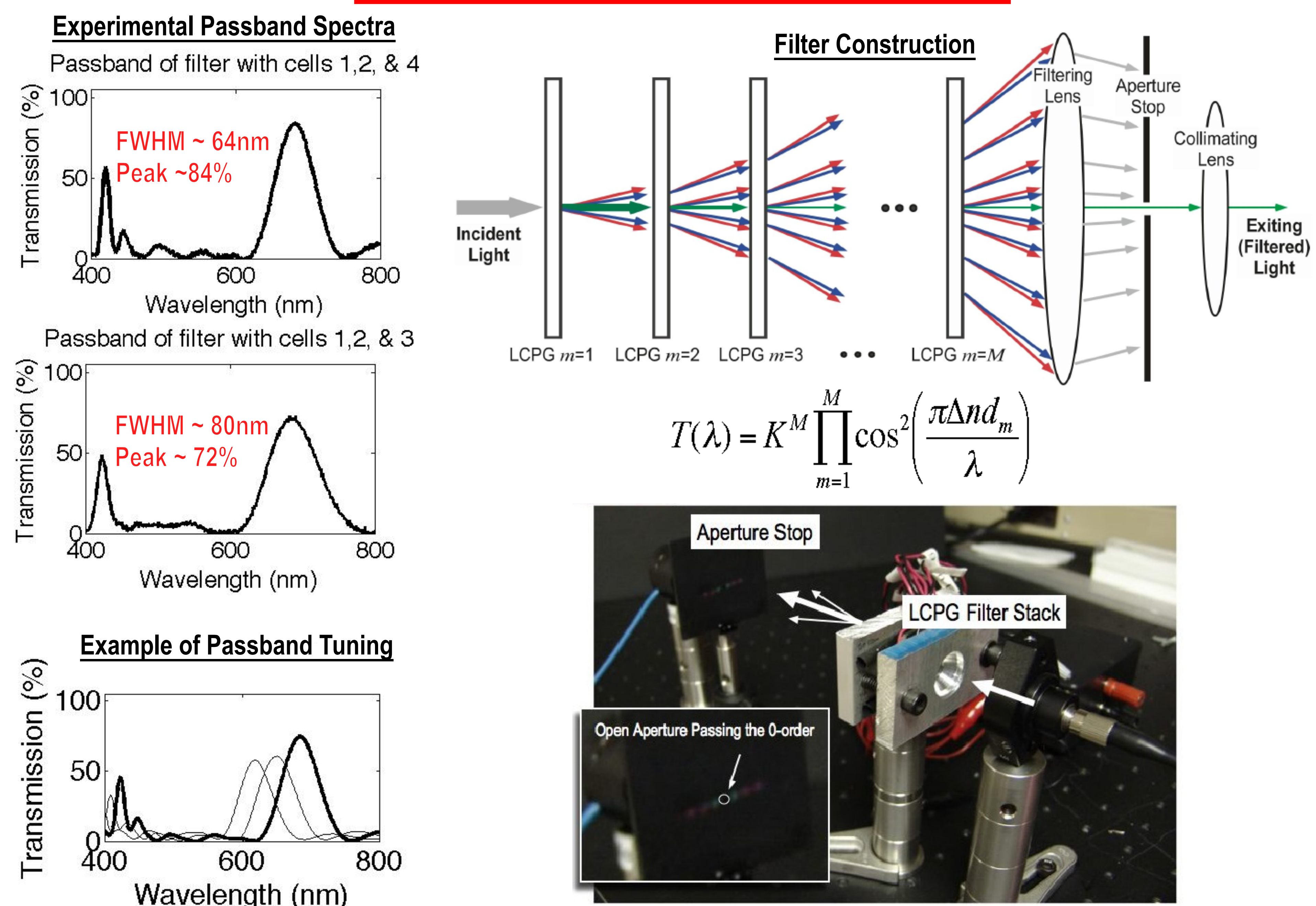


## BPG- Experimental Results



- The One Full Wave grating is an ordinary switchable polarization grating that exhibits one full-wave retardation at a center wavelength of ~685nm.
- The other three gratings are Bilayer Polarization Gratings with switchable layers that also exhibit one full-wave retardation at the design wavelength.
- The Two Full Wave grating has a polymer layer of thickness equal to one additional full wave retardation at the center wavelength.
- The Three and Four Full Wave gratings have polymer layers of thicknesses equal to 2 and 3 full wave retardations at ~685nm.

## Tunable Optical Filter



## Summary & References

- We experimentally demonstrated bilayer polarization gratings exhibiting all of the compelling properties of standard PGs, and additionally allowing for the fabrication of thick gratings at relatively low grating periods (15 $\mu$ m).
- We experimentally demonstrated a passband filter constructed from 3 bilayer polarization gratings and we showed that the exponential progression yields a lower FWHM (~64nm vs ~80nm with a linear progression).

### References

- [1] E Nicolescu and M J Escuti, "Polarization-Independent tunable optical filters based on liquid crystal polarization gratings," Proceedings of the SPIE, vol. 6654, no.4, 2007
- [2] M. J. Escuti, C. Oh, C. Sanchez, C. W. M Bastiaansen, and D. J. Broer, "Simplified spectropolarimetry using reactive mesogen polarization gratings," Proceedings of SPIE, vol. 6302, p. 630207, 2006.
- [3] L. Nikolova and T. Todorov, "Diffraction efficiency and selectivity of polarization holographic recording," Optica Acta vol. 31, pp. 579-588, 1984.
- [4] G. Crawford, J. Eakin, M. Radcliffe, A. Callan-Jones, and R. Pelcovits, "Liquid-crystal diffraction gratings using polarization holography alignment techniques," Journal of Applied Physics, vol. 98, p. 123102, 2005.

