Integrated Magneto-Optical Isolators Using Semiconductor-Friendly YIG

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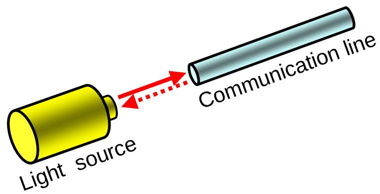
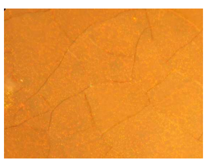
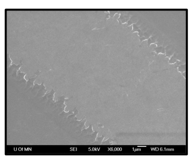


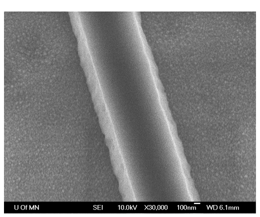
Light sources cannot be integrated w/ photonic integrated circuits (PICs) and OEICs

- *Back reflected light from insertion loss*
- *Damage to source, loss of mode-lock*
- *Optical interconnects are unprotected*





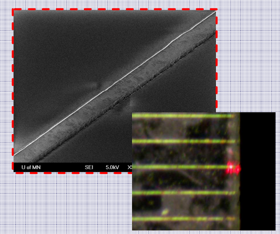
Usual cracking and etching issues of garnet on Si (above) have been overcome. See crack-free high-aspect-ratio waveguide (below)



MO garnet on Si

MAIN ACHIEVEMENT:

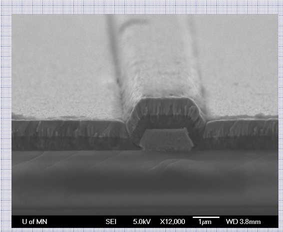
Garnet is the active material in magneto-optical isolators, but it is very difficult to integrate with Si.

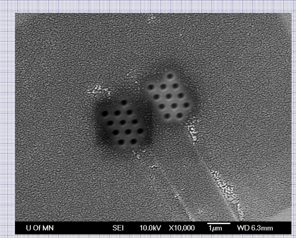


We have overcome this and have waveguided in integrated garnet. We also have integrated polarizers using photonic crystal technology.

HOW IT WORKS:

The garnet is biased with an integrated magnet (top film) that is on a cladding covering the waveguide. The polarizer is integrated in front of the guide so that backward traveling light can be blocked after being rotated by the garnet.



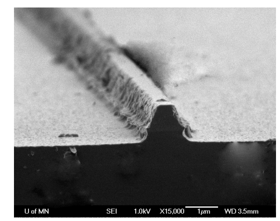


ASSUMPTIONS AND LIMITATIONS:

- It is assumed that future photonics will be on semiconductor platforms and that they'll want integrated sources.
- Devices now need to be developed with our garnet

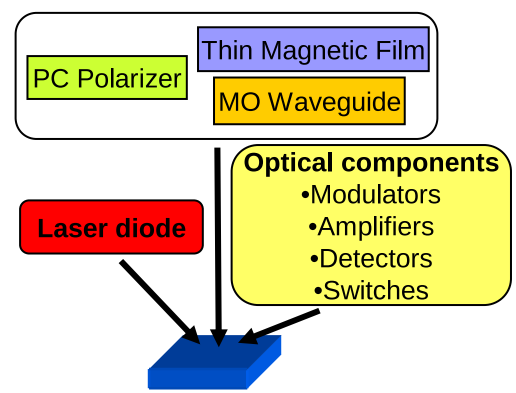
Other isolator designs will also <u>benefit from integrated garnet</u>:

- Quasi-phase matching for eliminating birefringence
- Mach-Zhender interferometers
- Garnet-clad semiconductor guides Ring Isolators
- MO garnet on SOI



MO garnet / Si waveguide on SOI

Integrated Optical Package



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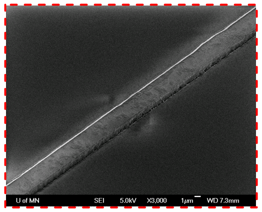
Integrated MO garnet allows integrated optical sources via isolators!

MINNESOTA

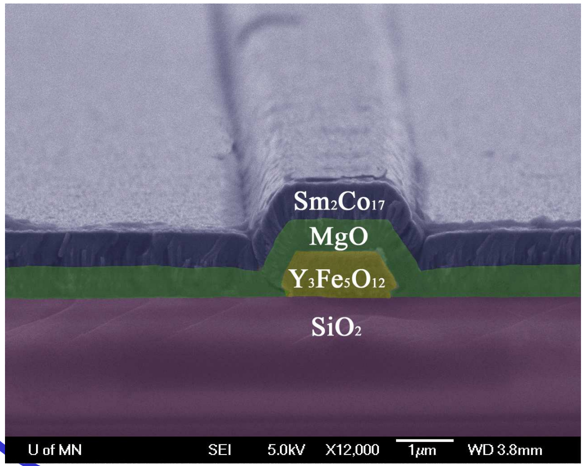
Integrated Optical Isolator on Semiconductor

Sang-Yeob Sung

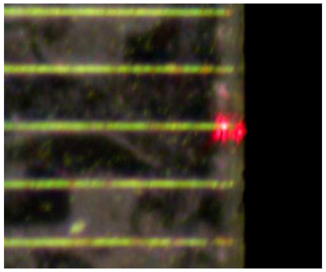
Fully integrated YIG optical Isolator on semiconductors



YIG ridge waveguide on Si wafer with SiO_2 cladding layer.

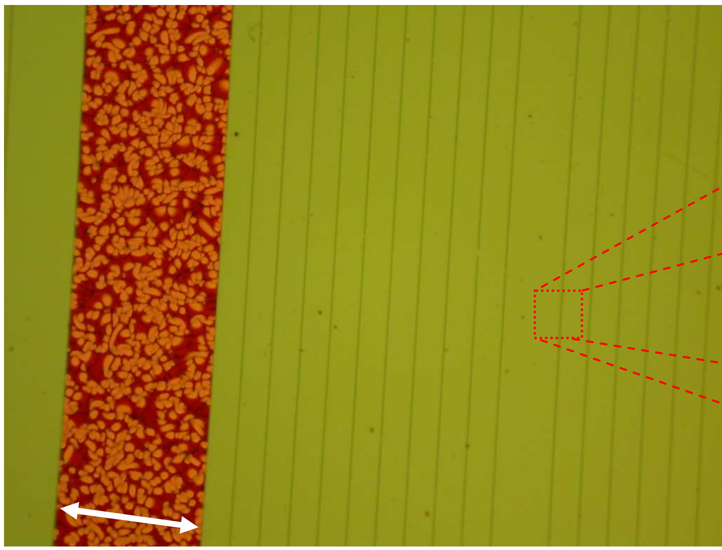


Integrated optical isolator

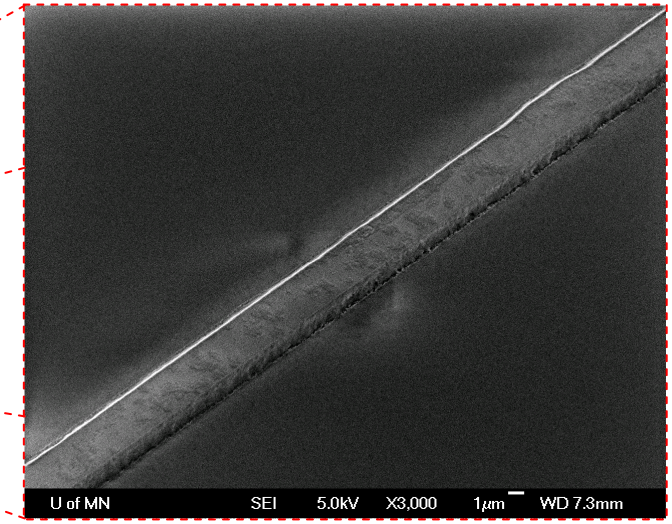


Waveguiding achieved

Fabricated YIG Waveguide on Semiconductor



500µm



Si/SiO_2/YIG

H_3PO_4 85%, 43℃

RTA 800°C 2m