Abstract: Thin film iron garnets like bismuth-substituted yttrium iron garnet (BiYIG) can be enablers for integrated non-reciprocal photonic devices such as isolators and circulators. Polycrystalline BiYIG films were grown on silicon substrates and waveguide devices in which a YIG seed layer is placed either above or below BiYIG to promote crystallization. The films exhibit the highest reported magneto-optical figure of merit of up to 769 °dB⁻¹ at 1550 nm wavelength. Apart from photonics, single crystal BiYIG films are also interesting for next generation spintronic memory. A record current driven domain wall velocity in perpendicularly magnetized BiYIG films exceeding 4300 m/s has been demonstrated in this work.

**Bismuth Iron Garnet Films for Nonreciprocal Photonics and Spintronics**

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**Iron garnets (A₃Fe₅O₁₂) are great MO materials**
- Substitute Y₃Fe₅O₁₂ with Bi to enhance MO properties
- Figure of Merit: Faraday Rotation/ Optical absorption
- YIG seed layer needed for crystallization of garnet on Si
- Seed layer weakens evanescent light reaching the garnet
  - Top-down crystallization preferred

**Different substrate temperatures (480–650 °C) and O₂ pressures (5–100 mTorr) used to grow BiYIG**
- Top-down YIG/Bi:YIG was demonstrated for the first time
- Figure-of-merit of films over an one order of magnitude higher that previous reports

**Grown high quality single crystal BiYIG**
- Films have Perpendicular Magnetic Anisotropy
- Ultra low damping ~ 5.3x 10⁻⁵
- 6.9nm BiYIG/Pt film has highest reported domain wall motion , 4.3km/s
- Introduced Dzyaloshinskii–Moriya interaction in BiYIG by adding Tm.