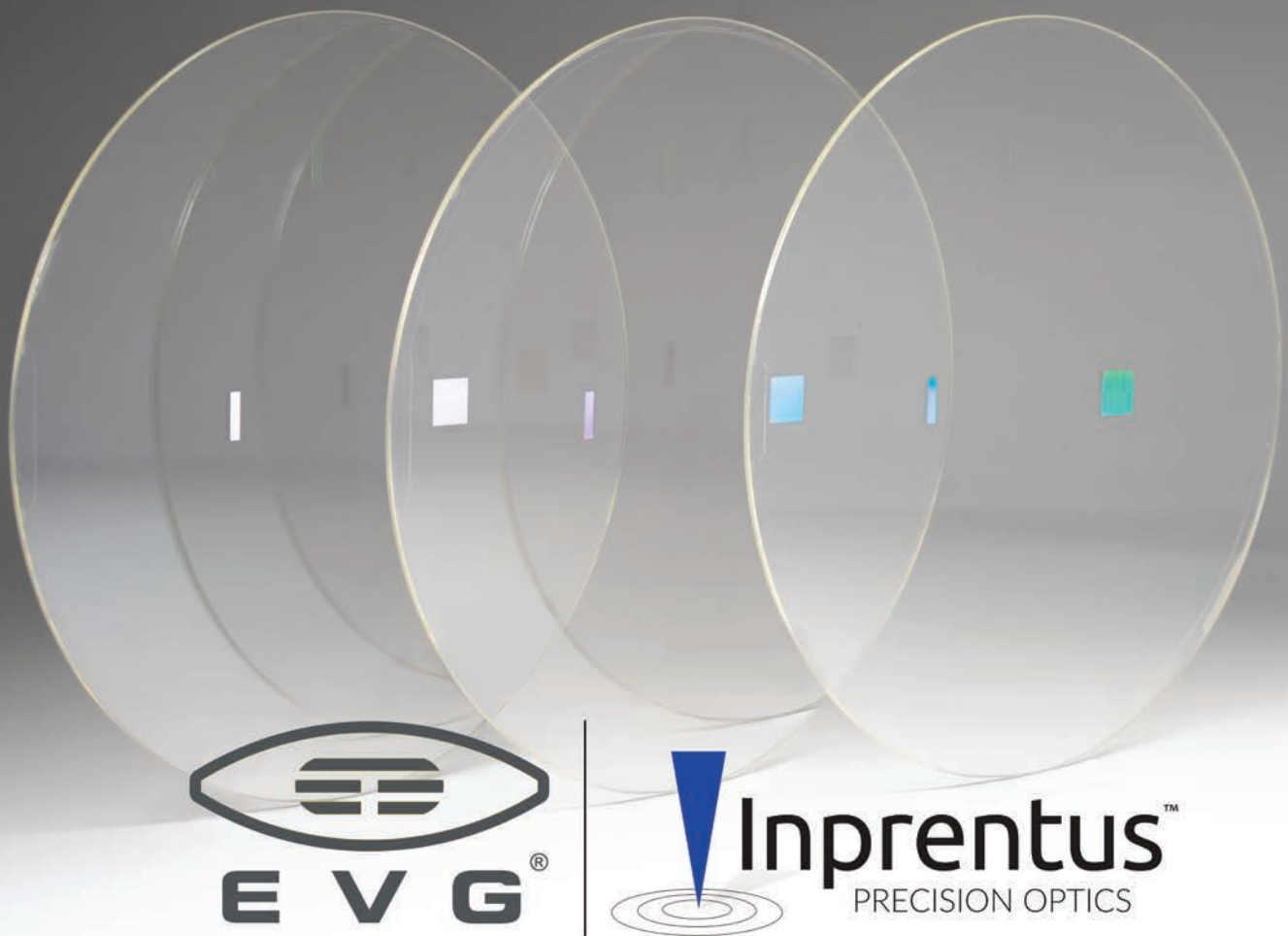




Blazed Grating Couplers for AR Waveguides

- **High-fidelity replication of blazed SRGs**
- **48% measured peak waveguide efficiencies**

Inprentus has partnered with EVG to design, master, and replicate a high-efficiency AR waveguide with blazed surface relief grating (SRG) couplers. Our optical simulations predict full waveguide device efficiencies near 70% and eye glow <5% over a specified region in the FOV. The optical efficiency of the fabricated waveguide device is measured and compared with simulations to show that blazed gratings provide excellent control of optical power over the FOV.

Inprentus has mechanically ruled a pair of symmetrical blazed SRGs in a thin gold film deposited on a 100 mm silicon wafer (master). The design of the coupler grating requires a blaze angle of 60° , a near-vertical antiblaze, and a groove spacing of 400 nm. This results in a groove with a height/width aspect ratio >1 which is a first for Inprentus. A SEM micrograph of the ruled grooves is shown in **Fig. 1a**. Inprentus has partnered with EVG to replicate the blazed SRG couplers. Nano-imprint lithography (NIL) was used to copy the gold master to a transparent waveguide with a refractive index $n=1.7$.

Inprentus has measured the optical efficiency of three replicated waveguides. Optical measurements are made on an in-house diffractometer using a He-Ne laser with a wavelength of 543 nm shown in **Fig. 2a**. For this measurement, the laser power extracted from the output coupler is recorded as a function of the AOI of the input beam. The light is trapped in the waveguide for the AOI range of -20° to $+20^\circ$ as shown in **Fig. 2b**. An extracted groove profile, shown in **Fig. 1b**, is used to simulate the performance of the fabricated waveguide. The simulated efficiency for the full device and the eye glow are plotted in **Fig. 3a** over a 40° FOV. A peak efficiency of 48% was recorded at $\sim 15^\circ$ AOI for all three waveguides as shown in **Fig. 3b**.

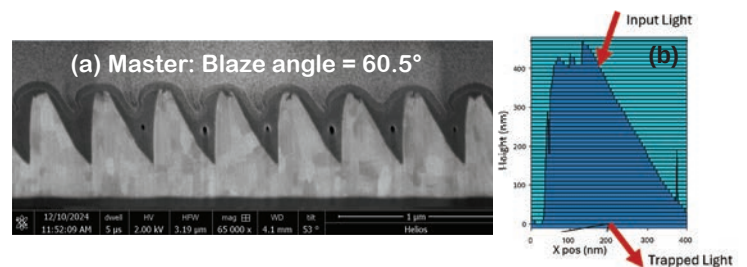


Figure 1. (a) SEM micrograph of ruled master SRG in gold, (b) Extracted groove profile for simulating performance of manufactured groove shapes.

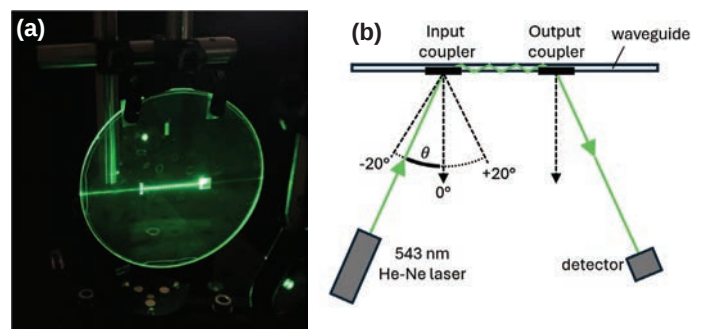


Figure 2. (a) EVG replica sample mounted on diffractometer for measurement, (b) top view schematic of diffractometer setup for waveguide efficiency measurements.

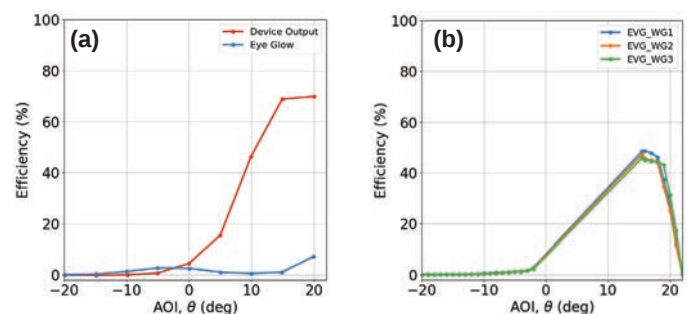


Figure 3. (a) Simulated device output efficiency (red) and light lost to eye glow (blue) (b) waveguide efficiency measurements for 3 EVG replicas.