LightMachinery Inc.
80, Colonnade Road
Ottawa, Ontario, K2E 7L2. Canada
Tel: (613) 749-4895 Fax (613) 749-8179

Spectrometer Application Report

Brillouin Spectroscopy of a Silicon Wafer

March 25, 2020

For questions, contact hyperfine@lightmachinery.com

Figure 1 shows the Brillouin spectrum of a silicon wafer, acquired using a camera cooled only at -5°C, limiting the exposure time to 10 seconds because of the dark current. The spectrum was averaged 50 times (thus accumulating the noise associated with 50 read-out events). A deeper cooled camera will be used in future work to allow for longer exposure time, which will result in a much higher signal-to-noise ratio with only a few minutes of total exposure. Nevertheless, even with a short exposure time, the spectrum in Figure 1 shows the great potential of the system.

The measured Brillouin frequency shift of the silicon wafer is 131.46 ± 0.07 GHz, in agreement with the expected shift. The pump laser signal is greatly attenuated (>70 dB) by the two "Pump Killers" included in the systems.

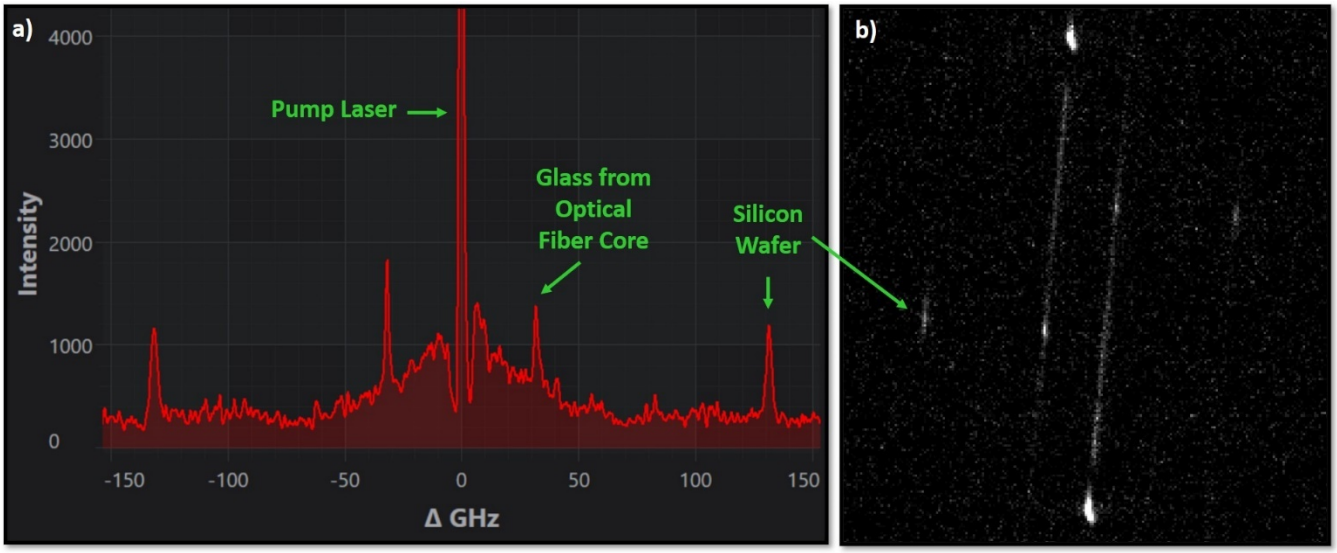

Figure 1: a) Brillouin frequency shift spectrum of a silicon wafer, acquired with a camera cooled only at -5°C. b) Raw sensor image. The exposure time was set to 10 seconds and the number of averages to 50.

Specifications

Sample	System
• Material: single crystal silicon wafer • The expected Brillouin frequency shift of silicon is around 131.6 GHz (using a longitudinal speed of sound in silicon of 8433 m/s, a refractive index of 4.151, and a pump wavelength of 532.2 nm)	• Pump wavelength: 532.2 nm • Power at sample: 25 mW • Excitation/collection with 20X objective • FWHM of the instrument response: nominal 0.9 GHz • Repeatability of Brillouin shift: highly sample and exposure dependent; < 10 MHz is possible