Reflectance and Transmittance Measurements in a Mock-Up Rapid Thermal Processing Chamber

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The objective of this work is to evaluate the transmittance and reflectance measurement techniques for temperature measurement in rapid thermal processing (RTP) furnaces. A mock-up chamber was constructed: it is an assembly that includes a top aluminum plate, a bottom aluminum plate, and three quartz pins that hold a 8”-diameter wafer in between. The main task is to measure the transmission and reflection of the wafer in such a pseudo *in situ* setting. This compact measurement setup shown in Fig. 1 employs fiber-coupled devices and diode lasers at 635 nm and 1550 nm wavelengths and an LED at a wavelength of 1550 nm. Si and Ge photodiode detectors are used for the 635 nm and 1550 nm measurements, respectively. A lock-in amplifier that sends a specific modulating frequency to the light source controller recovers the signals after the preamplifier. Surface roughness of the wafer backside was investigated with an optical interferometric profilometer and an atomic force microscope. In addition to *in situ* measurements, *ex situ* measurements were performed on the same wafers using a recently developed bidirectional scatterometer. The bidirectional reflectance distribution function (BRDF) for a sample with an rms roughness of 265 nm is shown in Fig. 2, for different incidence angles. While alignment remains a major challenge, our initial results demonstrate the feasibility of the *in situ* experimental setup and the influence of surface roughness on the transmittance and reflectance. Further analyses will be performed using a Monte Carlo method and an approximate model to investigate the specular and nonspecular reflection and transmission.

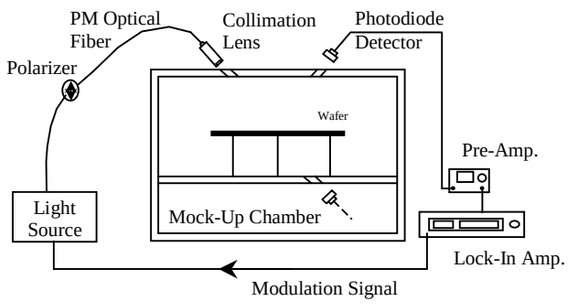

Fig. 1. Schematic of the *in situ* measurement setup.

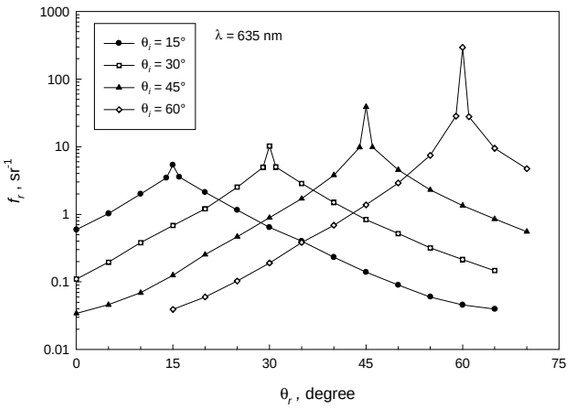

Fig. 2. BRDF data for the rough side of sample #2 when the azimuth angles are $\varphi_r = 180°$ and $\varphi_i = 0°$.

The work at the University of Florida was partially supported by the National Science Fundation under grant CTS-9875441 and by Mattson Technology.

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