Low Temperature and High Magnetic Field Ellipsometry System

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We report the design and implementation of a spectral ellipsometry system for samples placed under a low temperature (LT) ($\leq$ 4.2 K) and high magnetic field ($\leq$ 14 T) environment. Besides the light source (a Ti-sapphire laser at 700 - 1000 nm wavelength), readout and controlling electronics, the main structure of the system is integrated into an insert to fit an Oxford standard low-loss dewar with a 14-T superconducting magnet with a 50-mm bore. The insert has an optical head containing the polarizer and the rotating analyzer at room temperature (RT), a sample stage with a two-axis piezoelectric goniometer, and a 1.6-m long framework bridging the head and sample stage. After passing the polarizer, the laser beam is guided to the sample stage at LT; it is first reflected by a dielectric mirror before reaching the sample and the outgoing beam from the sample is then reflected to the analyzer at RT by a second dielectric mirror. All three reflections have a 60° incident angle and the same incident plane. To manifest the function and the sensitivity of this system, the differences of high-field ellipsometry parameters between an intrinsic GaAs substrate and a MBE-grown layer at 4.2 K are demonstrated.