Multiple-Channel Dual Phase Lock-in Optical Spectrometer

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Technology description

The development of a multiple-channel lock-in optical spectrometer (LIOS) is presented, which enables parallel phase-sensitive detection at the output of an optical spectrometer. The light intensity from a spectrally broad source is modulated at the reference frequency, and focused into a high-resolution imaging spectrometer. The height at which the light enters the spectrometer is controlled by an acousto-optic deflector, and the height information is preserved at the output focal plane. A two-dimensional InGaAs focal plane array collects light that has been dispersed in wavelength along the horizontal direction, and in time along the vertical direction. The data is demodulated using a high performance computer-based digital signal processor. This parallel approach greatly enhances (by more than 100x) the speed at which spectrally resolved lock-in data can be acquired. The noise performance of a working system optimized for the 1.3um wavelength range is analyzed using a laser diode light source. Time-resolved absorption traces are obtained for InAs quantum dots embedded in a GaAs matrix, and for dispersed films of PbSe nanocrystals. Chemical detection would be improved dramatically using this instrument. Enables >100x speedup in the acquisition of spectral data.

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