Fourier Transform Two-Dimensional Spectrometer
Technology #12810

Applications

This technology can be used to develop two-dimensional Fourier transform (2D FT) spectroscopy devices with a wide range of research applications involving the investigation of molecular dynamics, interactions, and structure.

Problem Addressed

Conventional 2D FT spectroscopy makes use of at least four separate laser pulses to obtain the time-domain signal. First, two pulses are used to excite the sample being studied. Subsequently, a probe pulse is used to generate the signal being measured. Finally, a fourth pulse is used to heterodyne the optical signal -- shifting it into a sufficiently low frequency to be detected and processed by electronic instrumentation. Small relative and absolute timing errors associated with the separate laser pulses need to be corrected through a time-consuming phasing process before the time-domain data collected can be converted into absorptive spectra using the Fourier transform. The complexity of these methods and the level of expertise needed to use them effectively has limited widespread usage of 2D FT spectroscopy in the wider scientific community.

Technology

The 2D FT spectroscopy technique described by the Inventors makes use of a collinear pulse pair for excitation. Since the collinear pulse pair originates from the same laser beam, and are indistinguishable with respect to time ordering, the time-consuming phasing process can be eliminated, thereby enabling real-time data acquisition. In addition, the optical configuration used for the probe field allows it to self-heterodyne, thereby eliminating the need for a fourth heterodyning pulse. Taken together, the process and equipment simplifications described in this invention significantly reduces the barriers to entry for 2D FT spectroscopy, and could make the technology accessible to a much wider audience within the scientific community.

Advantages

- Collinear pulse pair pump with well-defined phase relationship eliminates time-consuming phasing process
- Self-heterodyning probe field removes the need for additional heterodyning pulse
- Capable of integration with off-the-shelf FT infrared spectrometers

Categories For This Invention:

- Life Sciences
- Instrumentation
- Spectroscopy (Instrumentation)
Intellectual Property:
Two-dimensional fourier transform spectrometer
Issued US Patent
9,476,768
Two-dimensional fourier transform spectrometer
Issued US Patent
8,526,002
Two-dimensional fourier transform spectrometer
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Inventors:
Andrei Tokmakoff
Lauren DeFlores

Publications:
Two-Dimensional Fourier Transform Spectroscopy in the Pump–Probe Geometry
Optics Letters
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External Links:
Tokmakoff Group
http://web.mit.edu/~tokmakofflab/people.htm

Image Gallery: