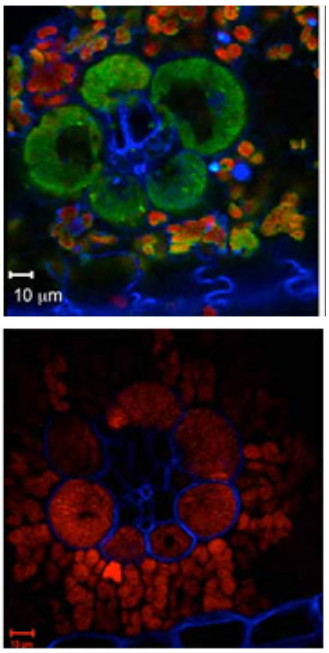
HYPERSPECTRAL IMAGING & MULTIVARIATE CURVE RESOLUTION

US Pat. No.: 6,675,106; 7,840,626; 7,451,173; 6,922,645; 7,725,517 and others
Technology Readiness Level: 5
Key components have been tested in relevant environments

Researchers at Sandia have designed and constructed a hyperspectral confocal fluorescence microscope. Hyperspectral microscopes image hundreds of spectral wavelengths when obtaining spectral images. Included in the hyperspectral imaging system are software programs for controlling the microscope and its data collection, as well as spectral image viewing software for viewing both the raw image data and the spectral and image results from the multivariate curve resolution (MCR) analyses.

The hyperspectral microscope allows for rapid detection of all emitting fluorescence species in an image and determines their relative concentrations throughout the image without any prior information. The microscope is combined with Sandia's unique and proprietary multivariate algorithms and software to form a complete system for the extraction of quantitative image information from the hyperspectral images at diffraction-limited spatial resolutions. Sandia's MCR software employs new algorithmic approaches to accomplish dramatically faster computation of the rigorous, constrained alternating least-squares MCR analysis.

This microscope system can reveal new fluorescent species that may not have been known to exist. It also allows an expansion of the structural stains and molecular fluorophores that biologists can introduce into biological samples simultaneously. This microscope and analysis system can accurately multiplex and recover the individual composition maps of each fluorophore, even if they are highly overlapped spectrally and/or spatially.



Sandia's hyperspectral fluorescence imaging system can distinguish between hundreds of dyes used to image biomass, as shown by the cross-sectional images of a corn leaf

TECHNICAL BENEFITS

- Allows blind unmixing of the hyperspectral images to determine and quantify all of the independently varying fluorescence species in the image
- Accurate detection and quantification of unexpected or unknown fluorescence species in imaged samples
- Changes in the pure emission spectra can be used to indirectly monitor the local environment of the fluorescent molecules in biological sample
- Hyperspectral imaging in a purely discovery mode for all those samples where the set of emission components is either not known or where the emission component spectra are dependent on the local environment of the sample
- Relative concentration maps of each of the emission components in sample can be obtained without fear of spectral cross talk from overlapping spectral components

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