Measurement Facilities:
Bio Imaging

The Polymers Division has established extensive and unique imaging capabilities for analyzing cell responses to materials. These include noninvasive, label-free imaging, automated image acquisition and quantitative image analysis. The Division houses a number of commercial and custom instruments as listed below:

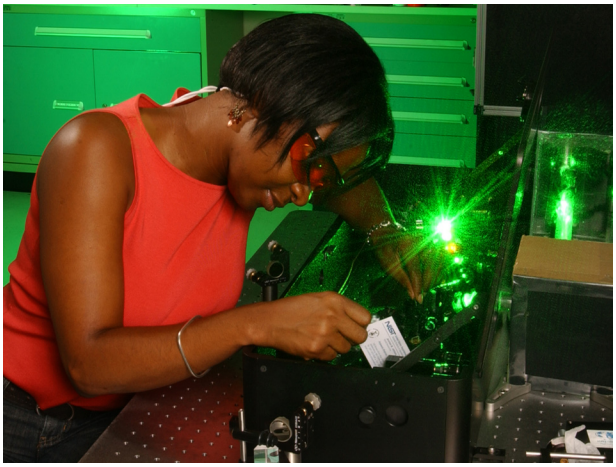
- broadbad coherent anti-Stokes Raman scat-tering (CARS) microscope (custom)
- optical coherence / two-photon microscope (OCM) (custom)
- laser-scanning confocal microscope
- automated fluorescence microscope
- x-ray micro-computed tomography
- Forster radiative energy transfer (FRET) / fluorescence correlation / fluorescence life-time imaging (FLIM) (custom)
- laser-capture microdissection

Noninvasive Label-Free Imaging

We have designed and built a broadband coherent anti-Stokes Raman scattering microscope. The first of its kind in the world, this microscope provides true chemical sensitivity and high spatial resolution with much higher signal efficiency than a spontaneous Raman microscope. This instrument has been used to map protein adhesion and phase behavior of mate-rials, as well as cell phenotype in cancer tissues. We have also designed an optical coherence microscope, which is able to image with high resolution and fidelity deep into scattering media, such as tissue or tissue scaffolds. A second generation of this instrument is being built by contract, and will include a co-linear two-photon microscope.

Automated Microscopy

We have engineered an automated image acquisition and analysis platform that includes commercial microscopes and custom control and analysis software, including rigorous statistical analysis.



First generation CARS and second generation OCM instruments are based on titanium:sapphire laser technology. The second gen-eration CARS microscope is built on newer, but more convenient ytterbium fiber technology.

The system enables bright field and multi-channel fluorescence imaging and analysis of very large data sets, which are critical to population-based assessments of cell and tissue morphology, biomarker specificity and cell population heterogeneity.
Quantitative Image Analysis

We have developed novel analysis tools for quantitation and visualization of microscopic features within tissue scaffolds. Pore size distribution, tortuosity, connectivity, permeability, percolation threshold and pore anisotropy can be computed. We have built analysis tools for use in NIST's immersive visualization environment (IVE); these tools allow for interactive visualization and quantitation of images in a virtual reality environment.

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FACILITIES