

## *Bodies of Organisms and Bodies of Water: Noninvasive Chemical Measurements in Turbid Samples*

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Light-based measurements are the approach of choice for the remote measurement of chemical properties. These approaches allow systems to be probed from a distance by adding a single chemical compound to 'report' the local chemical environment. A number of reporter molecules have been identified for ideal cases--i.e., when no suspended particles scatter light, and researcher has direct access to the sample. Real-world samples, for example the measurement of polyaromatic hydrocarbons in oil spill water samples or the noninvasive measurement 3D imaging of pH in the human body, typically require complex sample handling approaches. In both these cases, suspended particles (algae, dirt, cellular organelles, lipids, etc.) cause light scattering; simply put, we are looking into a 'fogbank'. A relatively new approach, photoacoustic imaging, can peek inside the fogbank. Briefly, imagine a take-out container with a dark lid on a table outdoors: the dark lid absorbs light, turns it into heat, inflating the container until the lid 'pops'. Similarly, molecules can absorb light, turn it into heat, and be located by the resulting ultrasonic wave. Our detectors 'see' the sound the molecule makes

just as in an ultrasound. This approach has been used to image hemoglobin in the body, but few other molecules have been identified with ideal properties for measurements or imaging in turbid systems. A key limitation in identifying new reporter molecules is that lasers are the light source, and nearly all lasers emit a single unchangeable color.



*The entire laser system; the unit on the left was purchased through the Internal Grant.*

One way to change the color of a laser is with a *dye laser*. Certain fluorescent dyes can change the color emitted by another laser to any color (wavelength) in the visible and infrared spectrum, while keeping the light pulse short enough to do photoacoustic research. I currently have a suitable laser that emits

ultraviolet light. By using certain dyes inside the new dye laser (and powered by my existing laser), I will be able to tune to any wavelength. With this capability, I will identify a molecular toolkit for both environmental monitoring and biomedical imaging. The required infrastructure (solvents, dyes, cuvettes, etc.) for this project is in place—except for the dye laser itself.