# Photonic Technologies for Noninvassive Detection, Diagnosis, and Treatment of Cancer

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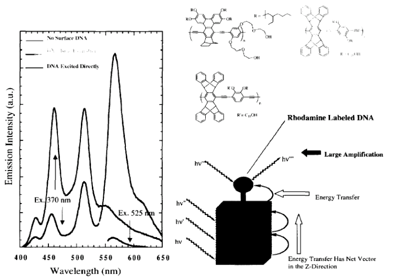


Figure 6. Multilayer film of three different bandgap polymers (largest band gap shown in blue, lowest in red). Excitation at 370 excites the blue polymer (emission max. 425nm) preferentially and energy is transferred in a vectorial process to the surface. The green curve shows the emission of the film before adsorbing DNA and the three emission bands correspond to the polymers. After adsorbing DNA, excitation at 370 nm results in a large rhodamine emission. The amplification is quantified by the ratio of this signal to the signal observed by direct excitation of the DNA at 525 nm. Broad band excitation of all three polymers produces an extremely strong DNA signal.

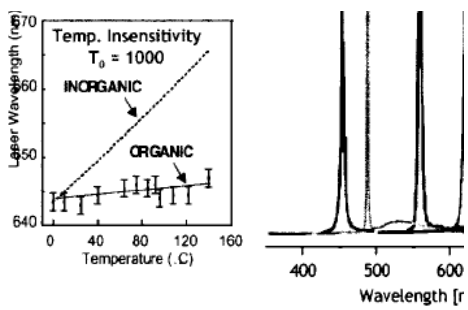


**FIGURE 14.** Optically pumped Organic Semiconduct (top) Schematic cross section. (bottom) Temperatu organic (data) and typical inorganic (dashed line) (right) Emission spectra of several OSLs.

## Description

The proposed SPM platform requires thin films of specially designed **SA** polymers which are only available through complex organic syntheses. The development of polymers that behave well in thin films is not trivial, as interpolymer interactions generally have a large effect on electronic and photophysical properties. In particular, the aggregation of electronic polymers greatly reduces amplification while also raising the threshold for laser behavior (lasing). The latter is extremely sensitive to any losses, and having an optimal system is important. New **SA** sensory polymers developed at MIT have the highest thin-film fluorescence quantum yields measured to date for semiconducting polymers. As the performance of the SPM technology will be critically and exponentially dependent on these materials, the ability of the MIT
group to design the optimum **SA** polymers cannot be overstated.

## Innovative Claims/NASA Significance

The development of a versatile and sophisticated photonic platform based on a new semiconducting polymer and microsphere (SPM) technology that can be tailored to both detect and treat cancer. This approach is not simply an incremental advancement of fiber-optic sensor and photodynamic therapy technologies. The sensor SPMs will have sensitivities many orders of magnitude beyond those provided by conventional methods. The enhancements will be provided by Integrating concepts first reported by Swager in 1995, wherein he demonstrated that semiconducting polymers are capable of a signal-amplifying **(SA)** sensory response.

## Plans

Milestones

**Year 1**

1. Purchase and set up a confocal microscope with a time-resolved laser for analysis of microsphere
2. Synthesize quantities of necessary polymers (this task will continue when necessary in Years ***2*** and **3).**
3. Use surface functionalization chemistry to produce microsphere lasers based on Self-Amplifying (SA)
4. Produce tailored multilayer films of electronic polymers in microsphere lasers.
5. Establish the conditions for optimal lasing and sensory behavior.
6. Demonstrate of the amplification of DNA bindinghybridization with a microsphere.
7. Begin Chemical Vapor Deposition (CVD) deposition of SA polymers on microspheres.
lasers and develop a testing station for fiber optic sensors.
polymers.