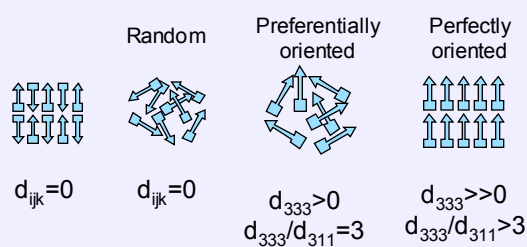


Fabrication and Characterization of Supramolecular Assemblies as Organic Thin Films for Photonics

Bweh Esembeson, Ivan Biaggio

Second Order Effects [$\chi^{(2)}$]

Non-centrosymmetry is required



Small molecules that do not decompose upon sublimation can be used to fabricate high density thin films and mask-defined microstructures and waveguides for integrated nonlinear optics on a chip by **vapor deposition**

Self-assembly into a dense, oriented structure through directional hydrogen bonding

Molecules are packed together into a high density solid state material with very high nonlinear optical susceptibility

Electro-optic modulation
Difference frequency generation
Second harmonic generation
Quasi-phase matched structures

Third Order effects [$\chi^{(3)}$]

Non-centrosymmetry is not required

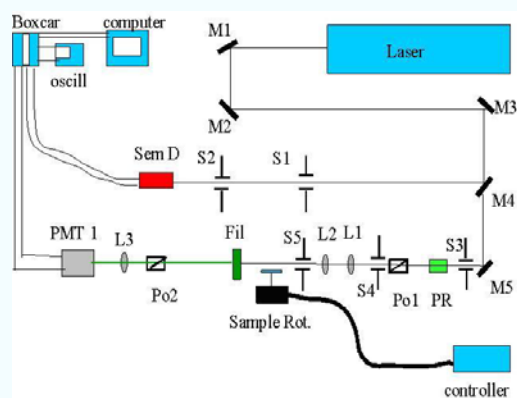
Deposition of compact molecules that pack a high nonlinearity in a small volume: donor substituted cyanoethynylethyne molecules

All optical switching
Optical limiting
Two-photon absorption

Vacuum Deposition System

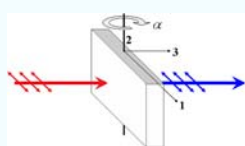


- Preparation of homogeneous thin films and waveguides with good thermal and photo-stability
- Create samples with fine control of film thickness
- Use masks to define waveguides and other structures.
- Combine molecular films with other structures, like waveguides, microcavities, interferometers, etc

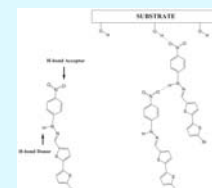
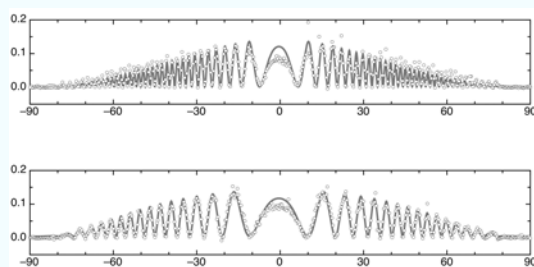


- Determination of nonlinear susceptibilities.
- Determination of average molecular orientation from angular dependence of second harmonic intensity.
- Investigation of ferroelectric nanocrystals embedded in glass.

2mm Quartz crystal



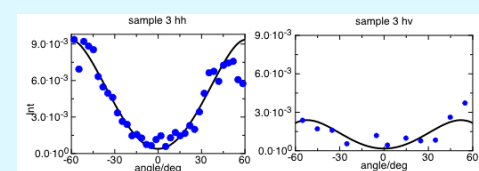
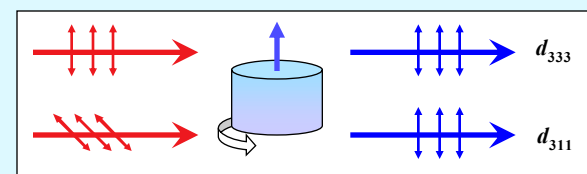
Maker fringes obtained



2-Bithiophene-4-Nitrophenyl Hydrazone
[Rashid et al., Adv. Mater. 15 (2003)]

Noncentrosymmetry enforced by the substrate

- One noncentrosymmetric axis caused by a preferential orientation mechanism
- Rotationally symmetric in the plane perpendicular to this axis.
- Two important nonlinear optical coefficients, their relative size is a measure of the ordering.



This demonstrate a preferential molecular orientation perpendicular to the substrate