Motivation: Nonlinear Optics (NLO)

Applications
- Optical telecommunications
- Wavelength conversion of lasers

Challenges
- Inorganic crystals (widely used) has *weak NLO response*

Introduction

*p,p*-dimethylaminonitrostilbene (DANS)

Organic molecules
- Strong and fast NLO response
- Cheap and solution based processing

Challenge
- A pairwise alignment in 2D or 3D bulk

Cancelling out
NLO response

DANS inserted carbon nanotubes (CNT)

CNT
- Allotropes of carbon
- Cylindrical structure = 1D

S. Cambre et al. (2015)[1]
- 70 DANS inside single tube of CNT
- Showed hyperpolarizability of 9,800 × 10⁻²⁰ e.s.u.

Goal
- Multiple aligned CNT film
- Huge hyperpolarizability

Method: Vacuum Filtration[2]

- Globally aligned, highly packed
- Controllable thickness
- Simple procedure

Result1: Oxygen Plasma Treatment Time

Film was not obtained by vacuum filtration

Different interaction between tubes due to DANS inside

Oxygen plasma treatment
- Changes surface potential
- More hydrophilic

Result2: Electric Field Induced Vacuum Filtration

- Each tube has dipole moment
- They should align to electric field applied

Nothing left on the filter membrane
(All CNT passed it through)

The effect of DANS inside CNT

With DANS	Without DANS

- Dipole moment is not the cause
- Applied electric field changes the filter membrane condition

Conclusion

- Tube interaction varied from one without DANS inside.
- Aligned film of DANS inside CNT with LDr of 0.57 was obtained.
- Applied electric field changed the filter membrane surface condition.

Future Work

- Measurement of hyperpolarizability
- Investigation of the effect of applying electric field to filter membrane

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Reference