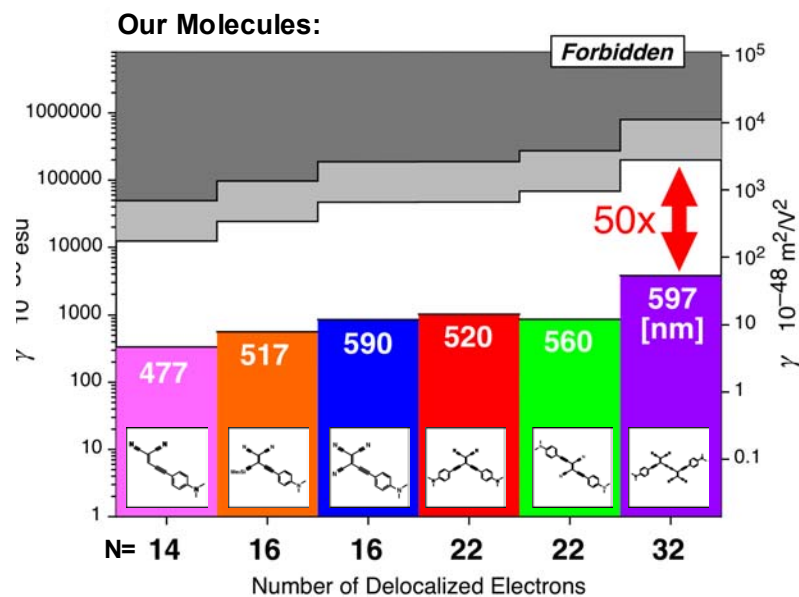
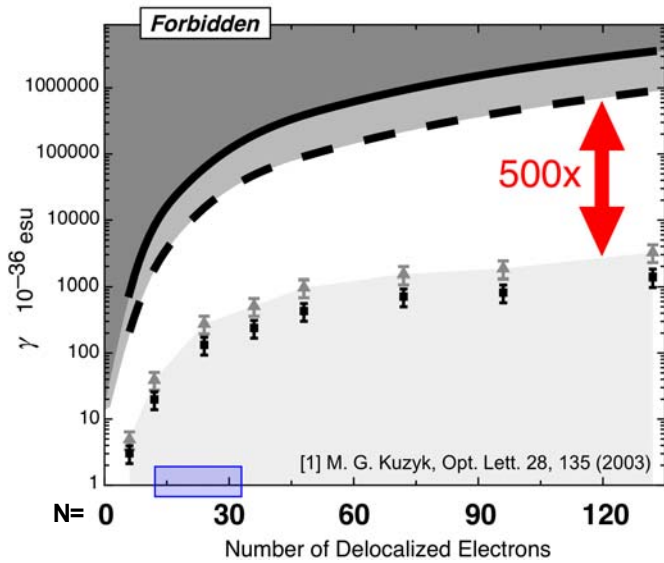


A New Family Of Compact Organic Molecules With Record-High Susceptibilities For All-Optical Switching

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Comparing to the Fundamental Limit:



Previous Measurements of Molecular Third Order Nonlinearity Were **500x Lower** Than The Theoretical Limit.¹

Our Molecules Are Only **50x Lower** Than The Theoretical Limit.

A 1000% Improvement!

- ✓ They are small, but pack a *huge nonlinearity*
- ✓ They can be *vapor deposited* without decomposition
- ✓ They are candidates for a *next generation* of integrated optical devices

The third-order susceptibility,

$\chi^{(3)}(-\omega, \omega, -\omega, \omega)$, describes both the intensity dependent refractive index and the intensity dependent absorption.

$$n(I) = n + n_2 I \quad n_2 \propto \text{Re}[\chi^{(3)}]$$

$$\alpha(I) = \alpha + \alpha_2 I \quad \alpha_2 \propto \text{Im}[\chi^{(3)}]$$

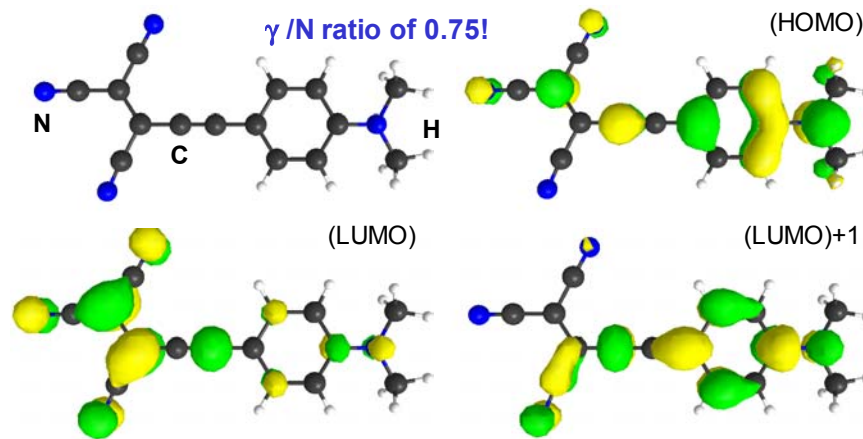
Molecular third-order nonlinearities are described by the second hyperpolarizability, γ , and are connected to the macroscopic third order susceptibility, $\chi^{(3)}$, by a local field factor, f , and the number of molecules, N .

$$\chi^{(3)} = N f^4 \gamma$$

DMA Substituted Cyanoethynylethyne (CEE):

Characteristics of a molecule with high γ :

- Strong Dipole Transition. e.g. Longer, More Effective Conjugation
- Small Energy Difference Between Transition States

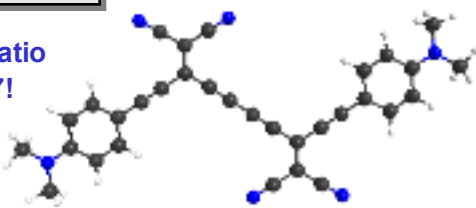


Possible Applications:

- All-Optical Switching
- Self-Phase Modulation
- Optical Limiting
- Two-Photon Absorption

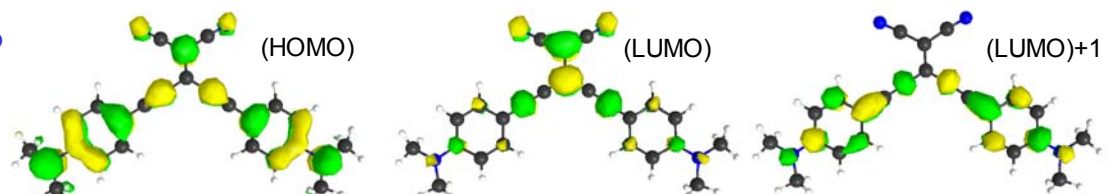
Dimer:

γ/N ratio of 1.7!

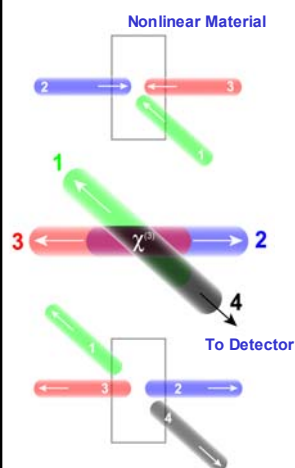


Molecular Variation:

γ/N ratio of 0.66!



Degenerate Four Wave Mixing (DFWM):



1. Three laser pulses are sent into a nonlinear material.
2. The pulses have a third-order interaction, $\chi^{(3)}$, creating a fourth pulse.
3. The fourth pulse is measured and compared to a known reference.

Nonlinear Spectroscopy Measurements:

