

# NLO Chromophores

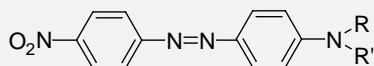
The field of **organic** nonlinear optics has come a long way since the triggering development in 1970. In that year, Davydov et al. reported a strong second harmonic generation (SHG) in organic molecules having electron donor and acceptor groups connected with a benzene ring.<sup>1</sup> In general, second-order nonlinearity originates from an organic molecule such as the one shown in Figure 1 **and** having an acentric structure.



Figure 1

These push-pull chromophores, specially tailored for large optical nonlinearity, are being applied in emerging electronic and photonic technologies. They are replacing the existing technology that is based on inorganic single crystals, which are expensive, difficult to grow in high quality, and are not easy to incorporate in electronic devices.<sup>2</sup>

Aldrich offers a large selection of nonlinear optically active (NLO) chromophores and intermediates for NLO polymers. A sampling of NLO chromophores is highlighted below with application information. For a comprehensive list, visit our award-winning Web site, [www.sigma-aldrich.com](http://www.sigma-aldrich.com), and search our product database in eight different ways including by substructure! If you are interested in special material grades, e.g., low metals dyes, please contact us at [aldrich@sial.com](mailto:aldrich@sial.com). For larger quantities, contact Sigma-Aldrich Fine Chemicals at **800-336-9719** (USA) or your local Sigma-Aldrich office.



R=R'=H

**36,479-7 Disperse Orange 3** **5g; 25g**  
[C.I. 11005, 4-(4-nitrophenylazo)aniline]

Used to provide experimental verification of a two-level model for the enhancement of the nonresonant, nonlinear refractive index, with a decrease in absorption by reduction of donor group strength.<sup>3</sup>

R=CH<sub>2</sub>CH<sub>3</sub>, R'=CH<sub>2</sub>CH<sub>2</sub>OH

**34,420-6 Disperse Red 1** **5g; 25g**  
[C.I. 11110]

This benchmark dipolar chromophore was incorporated into aromatic polymers to obtain model electrooptic polymer films.<sup>4</sup>

R=CH<sub>2</sub>CH<sub>3</sub>, R'=CH<sub>2</sub>CH<sub>2</sub>CN

**36,481-9 Disperse Orange 25** **1g; 5g**  
[3-[Nethyl-4-(4-nitrophenylazo)phenylamino]propionitrile]

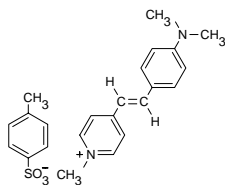
Adsorptive incorporation into molecular sieves yielded nanocomposites with nonlinear and photosensitive optical properties.<sup>5</sup>

**51,416-0**

**trans-4-[4-(Dimethylamino)styryl]-1-methylpyridinium *p*-toluenesulfonate,** **98%** **5g**

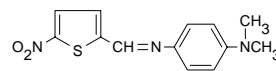
Powder SHG of this *N*-methylstilbazolium salt showed an efficiency 2000 times that of a urea standard.<sup>6</sup>

Also available: iodide salt, **33,640-8**; other stilbazolium derivatives: **36,684-6**; **36,683-8**



**51,638-4**

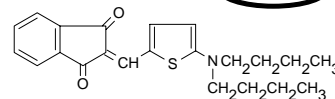
***N,N*-Dimethyl-*N'*-[5-nitro-2-thienyl)methylene]-1,4-phenylenediamine, 98%** **1g**



The molecular hyperpolarizability ( $\mu\beta$ ) of this nitro-substituted thiophene imino dye is greater than that of the analogous sulfone-substituted one, though the latter offers greater transparency in the visible range.<sup>7</sup>

**52,051-9**

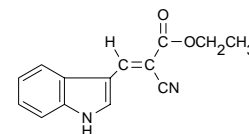
**2-[[5-(Dibutylamino)-2-thienyl]-methylene]-1*H*-indene-1,3(2*H*)-dione, 98%** **1g**



A nurocyanine chromophore based on a five-membered heterocycle for photorefractive applications.<sup>8</sup>

**E18,90-5**

**Ethyl *trans*- $\alpha$ -cyano-3-indoleacrylate,** **99%** **1g**



Example of a cyanovinylheteroaromatic for organic nonlinear optics.<sup>9</sup>

**References:** (1) Davydov, B.L. et al. *JEPT Lett.* **1970**, 12, 16. (2) Prasad, P.; Williams, D. *Introduction to Nonlinear Optical Effects In Molecules & Polymers*; John Wiley & Sons: New York, NY, 1991; Aldrich Catalog No. **222,382-4**. (3) Cherioux, F. et al. *Chem. Phys. Lett.* **2000**, 319, 669. (4) Barto, R. et al. *Polym. Prepr.—Am. Chem. Soc., Div. Polym. Chem.* **2000**, 41, 844. (5) Hoffmann, K. et al. *J. Inf. Rec.* **1998**, 24, 191. (6) Marder, S.R. et al. *SPIE Proc.* **1989**, 1147, 108. (7) Chou, S.-S.P. et al. *Chem. Commun.* **1996**, 1045. (8) Würthner, F. et al. *ibid.* **1998**, 1739. (9) Matsuoka, M. et al. *Mol. Cryst. Liq. Cryst.* **1990**, 182A, 71.



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