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Selenoxanthones via Directed Metalations in 2-Arylselenobenzamide Derivatives

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Abstract: The reaction of *N*, *N*-diethyl 4-(*N*′, *N*′-dimethylamino)-2-phenylselenobenzamide (**7a**), *N*, *N*-diethyl 4-methoxy-2-phenylselenobenzamide (**7b**), *N*, *N*-diethyl 4-(*N*′, *N*′-dimethylamino)-2-[(3-(*N*, *N*-dimethylamino)phenylseleno]-benzamide (**7c**), and *N*, *N*-diethyl 4-methoxy-2-(3-methoxyphenylseleno)-benzamide (**7d**) with excess lithium diisopropylamide (LDA) gave 2-*N*, *N*-(dimethylamino)-9*H*-selenoxanthone (**9a**), 2-methoxy-9*H*-selenoxanthone (**9b**), 2,7-bis-*N*, *N*-(dimethylamino)-9*H*-selenoxanthone (**9c**), and 2,5-dimethoxy-9*H*-selenoxanthone (**9d**) in 70%, 59%, 23%, and 90% isolated yields, respectively. *N*, *N*-Diethyl 2-phenylselenobenzamide (**2-Se**) gave no reaction with LDA, *t*-BuLi, MeLi, or lithium 2,2,6,6-tetramethylpiperidide as base. Electron donation from the 4-substituent of benzamide derivatives **7a**−**7d** may increase the directing ability of the carbonyl oxygen to metalate the 2-position of the arylseleno group.

Selenoxanthone derivatives are precursors to selenoxanthylium dyes and, in particular, to selenium-containing analogues of the rhodamines (9-aryl-2,7-diaminoxanthylium dyes). Rhodamine 123 (Rh-123) and related molecules have properties that make them useful in several biological applications: as fluorescent stains for mitochondria,[1] as tumor-selective dyes that accumulate in the mitochondria of cancer cells relative to normal cells,[2] and as chemotherapeutic agents against certain tumor lines.[3] Rh-123 has also shown phototoxicity upon irradiation of tumor cell lines treated with the dye, but the quantum yield for generating singlet oxygen, which is presumed to be the cytotoxic agent, is low and λ_{max} for Rh-123 is at too short a wavelength to be activated by light that penetrates tissue effectively.[4] Brominated[5] and iodinated[6] analogues of Rh-123 have been prepared and have higher quantum yields for the generation of singlet oxygen, but the have absorption maxima nearly identical to that of Rh-123.

In several classes of dyes, replacing an O or S atom with the heavier chalcogen atom Se gives higher quantum yields for the generation of singlet oxygen and longer wavelengths of absorption.[7−9] The higher quantum yields for the generation of singlet oxygen are a consequence of increased spin−orbit coupling from Se as a heavy atom (filled 3d shell), and the longer wavelengths of absorption are a consequence of less efficient Se4p−C2p orbital overlap and a smaller HOMO−LUMO gap. Substitution of Se for the O atom in the rhodamines should also give dyes with longer wavelengths of absorption and higher quantum yields for the generation of singlet oxygen.

The most general approaches to selenoxanthones have been the cyclization of 2-arylseleno benzoyl chloride and benzoic acid derivatives under Friedel−Crafts acylation conditions.[10] Unfortunately, the amino groups of selenoxanthone precursors to rhodamine analogues complex with the Lewis acids for the Friedel−Crafts acylation and are protonated under the conditions of acid-catalyzed cyclization. We sought an alternative route to selenoxanthones that would permit the facile incorporation of amino functionality.

Xanthones (**1-O**) and thioxanthones (**1-S)** have been prepared by ring closure of diphenyl ethers (**2-O**) and diphenyl sulfides (**2-S**) bearing a 2-amido substituent as shown in Scheme 1.[11] Long-range directed metalation gives intermediates **3**, which then lose $LiNEt_2$ to give the chalcogenoxanthones **1**. In all examples to date, attempted cyclization of diaryl selenides through directed metalation has failed.[11b] The lack of cyclization of **2-Se** to the selenoxanthone **1-Se** is presumably due to the lack of formation of intermediate **3-Se**, which has been unambiguously prepared by the addition of lithium arylselenide **4** to benzyne (**5**, Scheme 1).[12] Once intermediate **3-Se** is formed, selenoxanthone (**1-Se**) is isolated in 74% yield. Herein, we describe the first synthesis of selenoxanthones via long-range directed metalations of *N*, *N*-diethyl 2-phenylselenobenzamide derivatives. Presumably, derivatives of **3-Se** are formed as intermediates.

Attempts to cyclize **2-Se** with lithium diisopropylamide (LDA) failed to give any of the desired product.[11b] The lack of cyclization was attributed to the long Se−C bond, which would disfavor ring closure. However, the presumed intermediate **3-Se** can be formed via the addition

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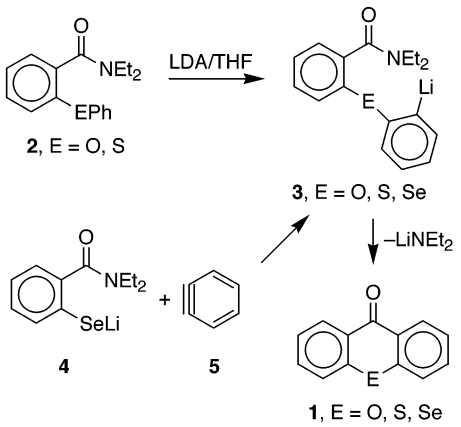
SCHEME 1



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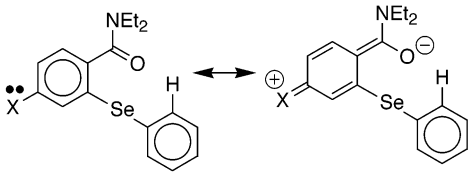


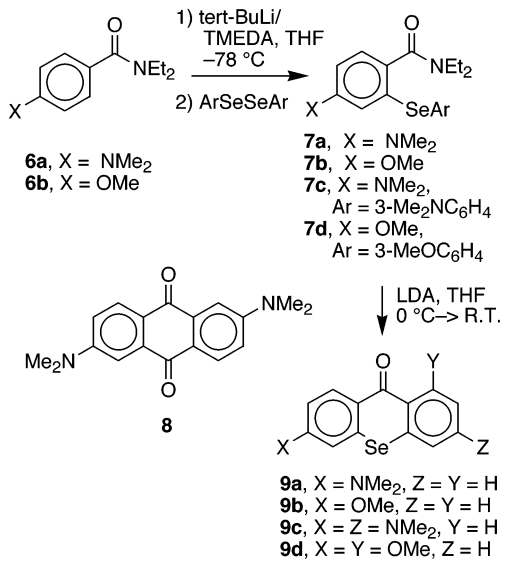
of LiSePh to benzyne and cyclization is observed to give selenoxanthone (**1-Se**).[12] Obviously, the Se−C bond length is not the primary reason for the lack of cyclization of **2-Se** in the presence of LDA. We thought that decreased acidity of the 2-proton of the phenylseleno substituent was more likely. Selenium is electropositive relative to O and S, which would increase electron density toward the C atom of the Se−C bond relative to O−C and S−C bonds. Inductive effects would decrease acidity at the 2-position of the phenylseleno group.

2-Phenylselenobenzamide derivatives substituted in the 4-position with heteroatoms capable of back-donation of a pair of electrons should increase the directing effect of the amide carbonyl as shown in Scheme 2. To this end we prepared analogues of **2** bearing 4-dimethylamino and 4-methoxy substituents.

N, *N*-Diethyl 4-(*N*′, *N*′-dimethylamino)benzamide (**6a**)[13] and *N*, *N*-diethyl 4-methoxybenzamide (**6b**)[14] are lithiated at the 2-position upon treatment with *t*-BuLi and *N*, *N*, *N*, *N*-tetramethylethylenediamine (TMEDA) in THF at −78 °C.[11] The addition of PhSeSePh to the 2-lithiated benzamide gave diarylselenides **7a** and **7b** in 74% and 70% isolated yields, respectively (Scheme 3). Similarly, the addition of di-3-(*N*, *N*-dimethylamino)phenyl diselenide[15] and di-3-methoxyphenyl diselenide[16] gave diaryl selenides **7c** and **7d** in 57% and 9% isolated yields, respectively. The yield of **7c** was unchanged using *s*-BuLi as base. However, the yield of **7d** improved to 47% upon using *s*-BuLi instead of *t*-BuLi.

The presence of TMEDA was critical to the success of the reaction since only dimerization of the lithiated

SCHEME 3



benzamide was observed in the absence of TMEDA. Benzamide derivative **7b** gave 2,6-di(*N*, *N*-dimethylamino)anthraquinone **8** and unreacted PhSeSePh as the only isolable products after treatment with either *s*-BuLI or *t*-BuLi in THF at −78 °C followed by the addition of PhSeSePh.

The 2-arylselenobenzamide derivatives were treated with 4 equiv of LDA for 1 h at 0 °C and then the reaction mixture was warmed to ambient temperature. 2-(*N*, *N*-Dimethylamino)-9*H*-selenoxanthone (**9a**) was isolated in 70% yield and 2-methoxy-9*H*-selenoxanthone (**9b**)[12] was isolated in 59% yield following workup. The cyclization of **7c** and **7d** to **9c** and **9d**, respectively, was sluggish at 0 °C with 4 equiv of LDA. Stirring **7c** with 8 equiv of LDA for 15 h at ambient temperature gave **9c**[17] in 23% yield (70% recovered **7c**) as a single isomer. Similarly, stirring **7d** with 4 equiv of LDA for 4 h at ambient temperature gave **9d** as a single isomer in 90% isolated yield.

The symmetry of **9c** was reflected in the 8-line ^{13}C NMR spectrum (1 carbonyl signal, 6 signals for aromatic C's, one aliphatic signal) and the 4-pattern ^{1}H NMR spectrum (a 3-proton 1,2,4-trisubstituted aromatic pattern, one 6-proton aliphatic singlet). While we expected to see a mixture of 2,7- and 2,5-isomers (**9**, X = Y = NMe_2, Z = H), we saw only the bis-2,7-(dimethylamino)selenoxanthone **9c**. The steric bulk of the dimethylamino substituent might hinder formation of the 2,5-isomer.

In contrast, the methoxy derivative **7d** gave only the 2,5-isomer **9d** and none of the 2,7-isomer (**9**, X = Z = OMe, Y = H) was detected by ^{1}H NMR spectroscopy. Selenoxanthone **9d** displayed a 15-line ^{13}C NMR spectrum (1 carbonyl signal, 12 signals for aromatic C's, two aliphatic C's) and an 8-pattern ^{1}H NMR spectrum (a 3-proton 1,2,4-trisubstituted aromatic pattern, a 3-proton 1,2,3-trisubstituted aromatic pattern, two 3-proton aliphatic singlets). The directing effect of the methoxy substituent and its smaller steric bulk relative to the dimethylamino substituent would favor formation of **9d**.

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We re-examined the cyclization of *N*, *N*-diethyl 2-phenylselenobenzamide (**2-Se**) with several different bases. As reported previously, LDA[11b] did not give cyclization but returned only unreacted **2-Se**. Similar results were obtained with lithium 2,2,6,6-tetramethylpiperidide. Both *t*-BuLi and MeLi consumed starting material. However, neither base gave detectable amounts of selenoxanthone **1-Se** from amide **2-Se**.

In summary, we have successfully prepared selenoxanthone derivatives via long-range directed metalations of *N*, *N*-diethyl 2-arylselenobenzamides bearing dimethylamino or methoxy substituents at the 4-position of the benzamide ring. The heteroatoms at these positions are critical to the success of the ring closure, perhaps by increasing the directing ability of the carbonyl oxygen as shown in Scheme 2. The approach also tolerates substituents in the arylseleno ring and allows the preparation of selenoxanthone **9c**, which is an immediate precursor to selenium-containing analogues of the rhodamines.

Experimental Section

Preparation of *N*, *N*-Diethyl 4-(*N*′, *N*′-Dimethylamino)-benzamide (6a).[13] Thionyl chloride (2.2 mL. 30 mmol) was added to a stirred solution of 4-(*N*, *N*-dimethylamino)benzoic acid (5.0 g, 30 mmol) in 20 mL of CH_2Cl_2 at 0 °C, and the resulting solution was stirred for 3 h at 0 °C. Diethylamine (6.8 mL, 66 mmol) was added dropwise. The resulting solution was stirred for 0.5 h at 0 °C and was then warmed to ambient temperature, where stirring was maintained for 1 h. Saturated aqueous $NaHCO_3$ (100 mL) was added slowly, and the product was extracted with CH_2Cl_2 (3 × 25 mL). The combined organic extracts were washed with brine, dried over $MgSO_4$, and concentrated. The crude product was purified via chromatography on SiO_2 eluted with ether to give a crystalline solid, which was recrystallized from 10% ether−hexanes to give 5.7 g (86%) of **6a** as white needles, mp 72−73 °C (lit.[13] mp 71−72 °C): ^{1}H NMR (CD_2Cl_2) δ 7.26 (AA′BB′, 2 H, J = 8.9 Hz), 6.68 (AA′BB′, 2 H, J = 8.9 Hz), 3.39 (br s, 4 H), 2.97 (s, 6 H), 1.16 (br t, 6 H, J = 7.0 Hz); ^{13}C NMR (CD_2Cl_2) δ 171.8, 151.5, 128.4, 124.9, 111.5, 40.4, 13.8.

Preparation of *N*, *N*-Diethyl 4-Methoxybenzamide (6b).[14] Thionyl chloride (10.5 mL, 17.2 g, 0.145 mol) was added to a stirred solution of 4-methoxybenzoic acid (10.0 g, 65.7 mmol) in 50 mL of benzene containing a drop of *N*, *N*-dimethylformamide at reflux, and the resulting solution was stirred for 2 h at reflux. The reaction mixture was concentrated, and the residue was dissolved in 60 mL of ether. Diethylamine (13.2 g, 197 mmol) in 30 mL of ether was added dropwise, and the resulting solution was stirred for 1 h at ambient temperature. The reaction mixture was poured into water, and the products were extracted with ether. The combined ether extracts were washed with cold 10% HCl, saturated $NaHCO_3$, and brine, dried over $MgSO_4$, and concentrated. The crude product was purified via chromatography on SiO_2 eluted with ether and was then recrystallized from MeOH to give 11.3 g (83%) of amide **6b** as a white, crystalline solid, mp 42−43 °C (lit.[14] mp: 42−43 °C): ^{1}H NMR ($CDCl_3$) δ 7.27 (AA′BB′, 2 H, J = 8.7 Hz), 6.82 (AA′BB′, 2 H, J = 8.7 Hz), 3.74 (s, 3 H), 3.38 (br s, 4 H), 1.11 (br s, 6 H).

Preparation of *N*, *N*-Diethyl 4-(Dimethylamino)-2-(phenylseleno)benzamide (7a). *tert*-Butyllithium (1.7 M in pentane, 1.2 mL, 2.0 mmol) was added dropwise to a stirred solution of **6a** (0.40 g, 1.8 mmol) and *N*, *N*, *N*, *N*-tetramethylethylenediamine (TMEDA, 0.31 mL, 2.0 mmol) in 10 mL of THF at −78 °C. After 0.5 h at −78 °C, PhSeSePh (0.57 g, 1.8 mmol) in 5 mL of THF was added dropwise. After 0.5 h at −78 °C, the reaction mixture was warmed to ambient temperature. Ten milliliters of saturated NH_4Cl was added, and the products were extracted with CH_2Cl_2 (3 × 25 mL). The combined organic extracts were washed with brine, dried over $MgSO_4$, and concentrated. The crude product was purified via chromatography on SiO_2 eluted with 10% ether/CH_2Cl_2 to give 0.50 g (74%) of **7a** as white crystals, mp 90−91 °C: ^{1}H NMR (CD_2Cl_2) δ 7.56 (m, 2 H), 7.30 (m, 3 H), 7.09 (d, 1 H, J = 8.9 Hz), 6.59 (m, 2 H), 3.35 (br s, 4 H), 2.81 (s, 6 H), 1.13 (br s, 6 H); ^{13}C NMR (CD_2Cl_2) δ 170.4, 151.1, 134.6, 131.1, 130.8, 129.5, 127.9, 127.6, 127.5, 116.5, 110.9, 40.2, 13.7; IR (KBr) 1619 cm^{-1}; HRMS (ES) *m*/*z* 377.1143 (calcd for $C_{19}H_{24}N_2O^{80}Se$ + H, 377.1132). Anal. Calcd for $C_{19}H_{24}N_2OSe$: C, 60.79; H, 6.44; N, 7.46. Found: C, 60.53; H, 6.45; N, 7.43.

Preparation of 2,7-Di(*N*,*N*-dimethylamino)anthraquinone (8). *tert*-Butyllithium (1.7 M in pentane, 1.2 mL, 2.0 mmol) or *s*-BuLi (1.3 M in pentane, 1.5 mL, 2.0 mmol) was added dropwise to a stirred solution of **6a** (0.40 g, 1.8 mmol) in 10 mL of THF at −78 °C. After 0.5 h at −78 °C, diphenyldiselenide (0.57 g, 1.8 mmol) in 5 mL of THF was added dropwise. After 0.5 h at −78 °C, the reaction mixture was warmed to ambient temperature. Ten milliliters of saturated NH_4Cl was added, and the products were extracted with CH_2Cl_2 (3 × 25 mL). The combined organic extracts were washed with brine, dried over $MgSO_4$, and concentrated. The crude product was purified via chromatography on SiO_2 eluted with 10% ether/CH_2Cl_2 to give 0.15 g (80%) of PhSeSePh and 0.20 g (75%) of **8** as an orange powder, mp 270−274 °C: ^{1}H NMR (CD_2Cl_2) δ 8.08 (d, 2 H, J = 8.7 Hz), 7.44 (d, 2 H, J = 2.7 Hz), 6.91 (dxd, 2 H, J = 2.7, 8.7 Hz), 3.16 (s, 12 H); IR (KBr) 2361, 1655, 1577 cm^{-1}; EIMS *m*/*z* 294 (calcd for $C_{18}H_{18}N_2O_2$, 294). Anal. Calcd for $C_{18}H_{18}N_2O_2$: C, 73.45; H, 6.16; N, 9.52. Found: C, 73.35; H, 6.22; N, 9.43.

Preparation of *N*, *N*-Diethyl 4-Methoxy-2-(phenylseleno)benzamide (7b). Amide **6b** (2.00 g, 9.65 mmol) in 25 mL of dry THF was treated with TMEDA (1.35 g, 11.6 mmol), 1.5 M *t*-BuLi in pentane (7.7 mL, 12 mmol), and PhSeSePh (3.01 g, 9.65 mmol) as described for **7a**. Product yield was 2.45 g (70%) of **7b** as a pale yellow oil: ^{1}H NMR (CD_2Cl_2) δ 7.63−7.58 (m, 2 H), 7.38−7.32 (m, 3, H), 7.19 (d, 1 H, J = 8 Hz), 6.81 (dxd, 1 H, J = 2, 8 Hz), 6.79 (d, 1 H, J = 2 Hz), 3.74 (s, 3 H), 3.55 (br s, 2 H), 3.25 (br s, 2 H), 1.26 (br s, 3 H), 1.10 (br s, 3 H); ^{13}C NMR (CD_2Cl_2) δ 169.6, 160.2, 135.0, 132.1, 131.7, 130.0, 129.7, 128.4, 127.7, 118.2, 112.5, 55.45, 43.35 (br), 39.3 (br), 14.3 (br), 12.9 (br); IR (NaCl plates) 1627 cm^{-1}; HRMS (ES) *m*/*z* 386.0629 (calcd for $C_{18}H_{21}NO_2{}^{80}Se$ + Na, 386.0630).

Preparation of *N*, *N*-Diethyl 4-*N*,*N*-Dimethylamino-2-[3-(*N*,*N*-dimethylamino)phenylseleno]benzamide (7c). Amide **6a** (0.79 g, 3.6 mmol) in 25 mL of dry THF was treated with TMEDA (0.43 g, 3.6 mmol), *t*-BuLi (1.7 M in pentane, 2.1 mL, 3.6 mmol) or *s*-BuLi (1.3 M in pentane, 2.8 mL, 3.6 mmol), and di-3-(*N*, *N*-dimethylamino)phenyl diselenide[15] (1.43 g, 3.6 mmol) as described for **7a**. Product yield was 0.83 g (57%) of **7c** as a pale yellow oil: ^{1}H NMR (CD_2Cl_2) δ 7.14 (t, 1 H, J = 8 Hz), 7.07 (d, 1 H, J = 8.5 Hz), 6.97 (t, 1 H, J = 2 Hz), 6.87 (d, 1 H, J = 8 Hz), 6.67 (dxd, 1 H, J = 2, 8.5 Hz), 6.64 (d, 1 H, J = 2 Hz), 6.57 (dxd, 1 H, J = 2, 8.5 Hz), 3.35 (br s, 4 H), 2.92 (s, 6 H), 2.82 (s, 6 H), 1.16 (br s, 6 H); ^{13}C NMR (CD_2Cl_2) δ 170.5, 151.6, 151.1, 131.3, 131.1, 129.9, 127.45, 127.43, 122.6, 118.6, 116.2, 112.2, 110.7, 43.0 (br), 40.6, 40.3, 13.8 (br); IR (NaCl plates) 1622, 1595 cm^{-1}; HRMS (EI) *m*/*z* 420.1551 (calcd for $C_{21}H_{29}N_3O^{80}Se$ + H, 420.1554).

Preparation of *N*,*N*-Diethyl 4-Methoxy-2-(3-methoxyphenylseleno)benzamide (7d). Amide **6b** (1.10 g, 5.37 mmol) in 25 mL of dry THF was treated with TMEDA (0.62 g, 5.37 mmol), 1.3 M *s*-BuLi in pentane (4.13 mL, 5.37 mmol), and di-3-methoxyphenyl diselenide[16] (2.00 g, 5.37 mmol) as described for **7a**. Product yield was 0.99 g (47%) of **7d** as a yellow oil: ^{1}H NMR (CD_2Cl_2) δ 7.38 (t, 1 H, J = 8.5 Hz), 7.10−7.18 (m, 3 H), 6.88 (dxdxd, 1 H, J = 1.8, 2.4, 8.5 Hz), 6.79 (m, 2 H), 3.79 (s, 3 H), 3.69 (s, 3 H), 3.52 (br s, 2 H), 3.20 (br s, 2 H), 1.22 (br s, 3 H), 1.08 (br s, 3 H); ^{13}C NMR ($CDCl_3$) δ 170.1, 160.3, 160.2, 131.9, 131.7, 130.7, 130.5, 127.7, 127.2, 118.3, 114.3, 112.7, 55.6, 55.5, 43.4 (br), 39.3 (br), 14.4 (br), 13.1 (br); HRMS (EI) *m*/*z* 394.0924 (calcd for $C_{19}H_{24}O_3N^{80}Se$ + H, 394.0921)

Preparation of 2-(*N*, *N*-Dimethylamino)-9*H*-selenoxanthone (9a). To a solution of **7a** (0.50 g, 1.3 mmol) in 10 mL of THF at 0 °C was added LDA (1.8 M in hexanes, 3.0 mL, 5.4

mmol). Upon completion of the addition, the reaction mixture was stirred 1 h at 0 °C and then warmed to ambient temperature, where stirring was maintained for 0.5 h. The reaction was quenched by the addition of 20 mL of saturated NH_4Cl. The products were extracted with CH_2Cl_2 (3 × 10 mL), washed with brine, dried over Na_2SO_4, and concentrated. The crude product was purified by sonication with ether followed by recrystallization from CH_3CN to give 0.28 g (70%) of **9a** as a yellow powder, mp 187−188 °C: ^{1}H NMR (CD_2Cl_2) δ 8.55 (d, 1 H, J = 7.9 Hz), 8.43 (d, 1 H, J = 9.2 Hz), 7.59 (d, 1 H, J = 7.9 Hz), 7.48 (t, 1 H, J = 7.0 Hz), 7.42 (t, 1 H, J = 8.0 Hz), 6.82 (dxd, 1 H, J = 2, 9.2 Hz), 6.75 (d, 1 H, J = 2 Hz); ^{13}C NMR (CD_2Cl_2) δ 180.4, 152.5, 137.4, 134.8, 132.7, 131.8, 131.7, 130.9, 128.4, 126.6, 119.9, 112.1, 107.9, 40.1; IR (KBr) 1586 cm^{-1}; HRMS (ES) *m*/*z* 304.0238 (calcd for $C_{15}H_{13}NO^{80}Se$ + H, 304.0241). Anal. Calcd for $C_{15}H_{13}NOSe$: C, 59.61; H, 4.34; N, 4.63. Found: C, 59.53; H, 4.33; N, 4.59.

Preparation of 2-Methoxy-9*H*-selenoxanthone (9b). Amide **7b** (0.500 g, 1.46 mmol) in 10 mL of dry THF at 0 °C was treated with LDA (1.8 M in hexanes, 3.2 mL, 5.8 mmol) as described for the preparation of selenoxanthone **9a**. Product yield was 0.236 g (59%) of selenoxanthone **9b** as an yellow powder, mp 125−126 °C: ^{1}H NMR (CD_2Cl_2) δ 8.58 (dxd, 1 H, J = 1.5, 8 Hz), 8.55 (d, 1 H, J = 9 Hz), 7.64 (dxd, 1 H, J = 1.5, 7.5 Hz), 7.54 (dxt, 1 H, J = 1.5, 7.5 Hz), 7.47 (dxt, 1 H, J = 1.5, 7.5 Hz), 7.11 (d, 1 H, J = 2.5 Hz), 7.03 (dxd, 1 H, J = 2.5, 9 Hz), 3.92 (s, 3 H); ^{13}C NMR (CD_2Cl_2) δ 162.1, 137.1, 135.3, 134.3, 132.8, 131.6, 130.7, 129.6, 127.9, 126.4, 124.2, 114.7, 110.6, 55.5; IR (KBr) 1592 cm^{-1}; HRMS (ES) *m*/*z* 290.9921 (calcd for $C_{13}H_{10}O_2{}^{80}Se$ + H, 290.9924). Anal. Calcd for $C_{14}H_{10}O_2Se$: C, 58.15; H, 3.49. Found: C, 58.13; H, 3.45.

Preparation of 2,7-Bis-*N*,*N*-(dimethylamino)-9*H*-selenoxanthone (9c).[17] Amide **7c** (0.19 g, 0.42 mmol) in 10 mL of dry THF at ambient temperature was treated with LDA (1.8 M in hexanes, 1.0 mL, 1.8 mmol) as described for the preparation of selenoxanthone **9a** except that stirring was continued for 15 h at ambient temperature. Unreacted starting material was recovered (0.13 g, 70%) as well as 0.033 g (23%) of **9c**, as a yellow-green, crystalline powder, mp 224−225 °C (lit. mp[17] 261−262 °C): ^{1}H NMR (CD_2Cl_2) δ 8.42 (d, 2 H, J = 9.2 Hz), 6.81 (dxd, 2 H, J = 2.4, 9.2 Hz), 6.74 (d, 2 H, J = 2.4 Hz), 3.11 (s, 12 H), ^{13}C NMR (CD_2Cl_2) δ 179.1, 151.6, 136.1, 131.6, 119.9, 111.0, 107.5, 39.53; IR (KBr) 1589 cm^{-1}; λ_{max} (EtOH) 388 nm; HRMS (ES) *m*/*z* 347.0669 (calcd for $C_{17}H_{18}ON_2{}^{80}Se$ + H, 347.0663). Anal. Calcd for $C_{17}H_{18}ON_2Se$: C, 59.13; H, 5.25; N, 8.11. Found: C, 59.22; H, 5.23; N, 8.07.

Preparation of 2,5-Dimethoxy-9*H*-selenoxanthone (9d). Amide **7d** (0.20 g, 0.51 mmol) in 5 mL of dry THF at ambient temperature was treated with LDA (1.8 M in hexanes, 2.2 mL, 4.0 mmol) as described for the preparation of selenoxanthone **9a** except that stirring was continued for 8 h at ambient temperature. Product yield was 0.145 g (90%) of **9d**, as a yellow-green, crystalline powder, mp 121−122 °C: ^{1}H NMR (CD_2Cl_2) δ 8.22 (d, 1 H, J = 8.5 Hz), 7.39 (t, 1 H, J = 8 Hz), 2.28 (dxd, 1 H, J = 1, 8 Hz),7.02 (d, 1 H, J = 2.5 Hz), 6.96 (dxd, 2 H, J = 2.5, 8.5 Hz), 6.94 (d, 1 H, J = 8 Hz), 3.93 (s, 6 H), 3.88 (s, 6 H); ^{13}C NMR (CD_2Cl_2) δ 182.1, 161.9, 161.5, 135.8, 134.1, 132.1, 132.0, 128.0, 121.3, 120.0, 114.2, 110.2, 110.0, 55.9, 55.5; IR (KBr) 1630, 1596 cm^{-1}; λ_{max} (CH_2Cl_2) 373, 302 (sh), 274 nm; HRMS (ES) *m*/*z* 321.0033 (calcd for $C_{15}H_{12}O_3{}^{80}Se$ + H, 321.0030). Anal. Calcd for $C_{15}H_{12}O_3Se$: C, 56.44; H, 3.79. Found: C, 56.59; H, 3.45.

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Supporting Information Available: ^{1}H NMR spectra for *N*, *N*-diethyl 2-arylselenobenzamide derivatives **7a**−**d** and selenoxanthones **9a**−**d** and ^{13}C NMR spectra for **7b**−**d**. This material is available free of charge via the Internet at http://pubs.acs.org.

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