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LETTERS
TO THE EDITOR

Synthesis and Spectral-Luminescent Properties of 2,5-Diaryl-1,3,4-oxadiazoles and Their Chelate Complexes with Cadmium(II)

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Abstract—Cyclization of *N*′-(arylcarbonyl)benzohydrazides in $SOCl_2$ has afforded 2-aryl-5-(4-octyloxyphenyl)-1*H*-1,3,4-oxadiazoles; the spectral-luminescent properties of the properties have been studied. The obtained cadmium complex based on 2-[5-(4-octyloxyphenyl)-1,3,4-oxadiazol-2-yl]phenol (L_2Cd) have exhibited strong violet luminescence.

Keywords: 2,5-diaryl-1,3,4-oxadiazoles, metal complexes, luminescence, organic and metal complex phosphors

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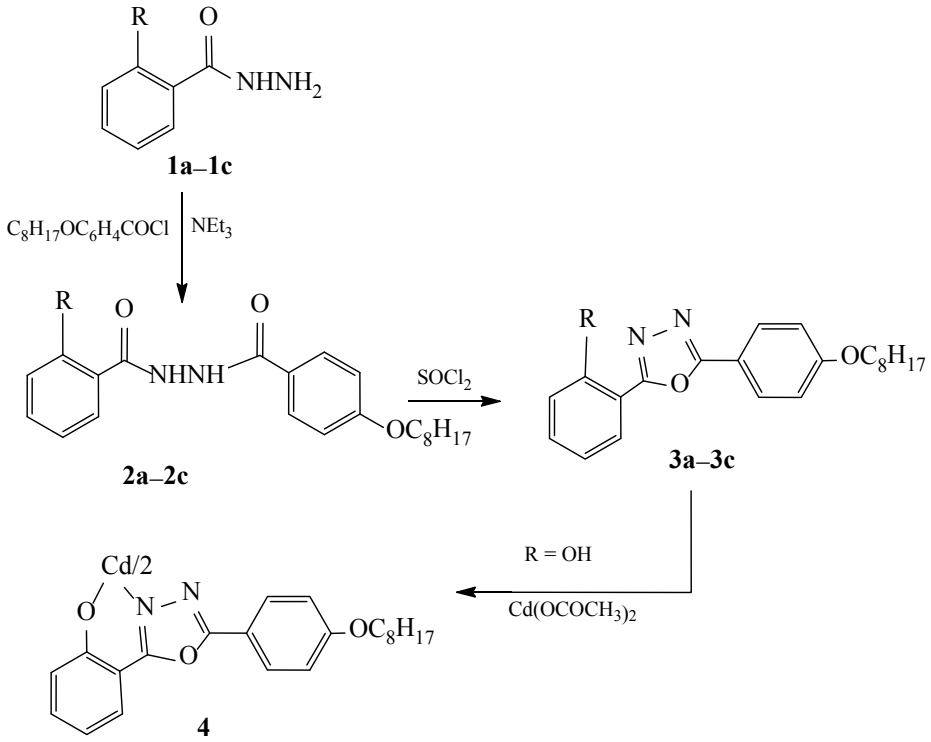
The interest to 2,5-diaryl-1,3,4-oxadiazoles and their derivatives is owing to their diverse biological activity [1] as well as their unique spectral-luminescent and photophysical properties [2–4] allowing the preparation of demanded organic phosphors exhibiting strong emission in the short-wave part of the visible range and low self-absorption [5, 6]. The presence of *ortho*-hydroxyphenyl substituents in positions 2 or 5 of the 1,3,4-oxadiazole cycle leads to the formation of the structures with strong six-membered bidentate N,O-chelating coordination node. These compounds have been recently used as fluorescent chemosensors for heavy metals cations [7] and in the synthesis of luminescent metal complexes [8–10] applied as highly efficient emission [11–13] and electron transport [14] materials in organic light-emitting diodes (OLEDs) and other modern photo- and electroluminescent devices.

To extend the rand of organic and metal complex phosphors containing the 2,5-diaryl-1,3,4-oxadiazole moiety and study their spectral-luminescent properties, we used aroylation of hydrazides **1a**–**1c** with *n*-octyloxybenzoyl chloride for the preparation of *N*′-(arylcarbonyl)benzohydrazides **2a**–**2c**, cyclization of which in thionyl chloride afforded 2-aryl-5-(4-octyloxyphenyl)-1*H*-1,3,4-oxadiazoles **3a**–**3c** (Scheme 1). The metal complex **4** soluble in organic media was synthesized using compound **3b**. The chelate complex of cadmium(II) (L_2Cd) **4** was obtained via refluxing of a mixture of compound **3b** (L) and $Cd(OCOCH_3)_2 \cdot 2H_2O$ (molar ratio 2 : 1) in methanol (Scheme 1).

Structure of compounds **2**–**4** was elucidated using the data of elemental analysis as well as IR, ^1H NMR, and ^{13}C NMR spectroscopy; spectral-luminescent properties of oxadiazoles **3a**–**3c** and cadmium complex **4** were studied.

IR spectra of oxadiazoles **3a**–**3c** and the metal complex **4** contained a group of medium-intensity bands at 1607–1628 and 1532–1595 cm^{-1} assigned to the stretching of the double bonds of the oxadiazole moiety (C=N) and the aromatic rings (C=C). The spectrum of complex **4** revealed the shift of the stretching band of the C=N bond involved in the complex formation (1612 cm^{-1}) by 14 cm^{-1} to lower frequency as compared to the respective band in the spectrum of compound **3b** (1626 cm^{-1}). Furthermore, the latter spectrum contained a broad band assigned to the stretching of the phenol OH group at 3161 cm^{-1}. That band was absent in the IR

Scheme 1.



R = H (**a**), OH (**b**), OMe (**c**).

spectra of compounds **3a**, **3c**, and **4** since oxadiazoles **3a**, **3c** did not contain the hydroxyl group, and its proton was substituted with the metal ion in complex **4**. The structure of complex **4** was confirmed by the ^{1}H and ^{13}C NMR spectra which contained the complete sets of the expected signals at their usual positions. Let us note the absence of the phenol OH signal in the proton spectrum of compound **4** (that signal was observed at 10.17 ppm in the spectrum of compound **3b**). Furthermore, the complex formation induced the downfield shift of the signals of the oxyphenyl fragment in the ^{1}H and ^{13}C NMR spectra of complex **4** in comparison with those of oxadiazole **3b**.

The electronic absorption spectra of oxadiazoles **3a**–**3c** showed the maximums of the long-wave band (assigned to the π→π*-transitions) at 318–335 nm, evidencing the benzoid structure of the compounds. The emission spectra of oxadiazole **3b** in isooctane, dioxane, and acetonitrile contained two weak bands: the short-wave one (λ^{fl}_{max} = 358–378 nm, φ = 0.001–0.004) with normal Stokes shift (2098–3665 cm^{-1}) and a long-wave (λ^{fl}_{max} = 469–483 nm, φ = 0.001–0.005) with unusually high Stokes shift (8529–9416 cm^{-1}). The short-wave band in the excitation spectra was assigned to the initial benzoid structure **3b**, and the long-wave one corresponded to the short-living phototautomer formed via intramolecular proton transfer in the excited state from the phenolic OH group to the nearest nitrogen atom of oxadiazole [6, 15]. Low overall quantum yield of luminescence of oxadiazole **3b** in those solvents (φ = 0.003–0.007) was due to the radiationless deactivation of the excited state via the ESIPT mechanism (Excited-State Intramolecular Proton Transfer). However, the spectrum of oxadiazole **3b** in a polar solvent (DMSO) contained a single strong short-wave band (λ^{fl}_{max} = 366 nm, φ = 0.32) with normal Stokes shift (2618 cm^{-1}) assigned to the initial benzoid structure **3b** according to the excitation spectra. The formation of a strong intermolecular hydrogen bond between the phenolic OH group of oxadiazole **3b** and a polar aprotic molecule (DMSO) inhibited the intramolecular proton transfer. Oxadiazoles **3a**, **3c** which did not contain the mobile phenolic OH proton exhibited high quantum yield of fluorescence (λ^{fl}_{max} = 352–377 nm, φ = 0.73–0.92) with normal Stokes shift (2694–5347 cm^{-1}). A similar spectral behavior has been observed earlier for structurally analogous 1,3,4-oxadiazoles [3, 4, 16, 17].

Even though cadmium complex **4** in acetonitrile and DMSO revealed absorption at longer wavelengths (λ_{max} = 372, 373 nm) in comparison with oxadiazoles

3a–**3c**, the presence of a band due to the charge transfer between the ligand and the metal led to the appearance of its single emission band between those of the benzoid structure and the phototautomer (CH_3CN, λ^{fl}_{max} = 432 nm; DMSO, λ^{fl}_{max} = 443 nm). Rigid configuration of the cadmium complex **4** prevented radiationless deactivation of its excited state, and therefore it exhibited strong (φ = 0.28, 0.35) violet luminescence. Hence, complex **4** could be regarded as efficient metal complex phosphor, and the oxadiazole ligand **3b** could act as a chemosensor with respect to toxic cadmium cations.

4-Octyloxy-*N*'-(phenylcarbonyl)benzohydrazide (2a). 2 mL of triethylamine and then a solution of 1.34 g (0.005 mol) of 4-octyloxybenzoyl chloride in 20 mL of anhydrous benzene were added at stirring to a solution of 0.68 g (0.005 mol) of benzohydrazide **1a** in 50 mL of anhydrous benzene. The reaction mixture was stirred during 2 h at room temperature and then refluxed during 6 h. The solvent was removed in vacuum, and 50 g of crushed ice was added to the oily residue. The formed precipitate was filtered off, washed with water (2× 10 mL), dried in air, and recrystallized from isopropanol (2×20 mL). Yield 1.53 g (83%), colorless crystals, mp 125–127°C. IR spectrum, ν, cm^{-1}: 3201 (N–H), 1663, 1622 (C=O, amide), 1602, 1599 (C=C); 1572 (N–H), 1509, 1445, 1368; 1314, 1272 [ν_s(Ar–O–C)]; 1119, 1103 (C–O–C); 1043, 975; 844, 809 [$\delta(C_{Ar}H)$]; 745, 736 [δ(CH)]. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 0.87 t (3H, CH_3, Oct, J = 7.2 Hz), 1.26–1.58 m (10H, CH_2, Oct), 1.64–1.83 m (2H, CH_2, Oct), 4.11 t (2H, OCH_2, Oct, J = 6.6 Hz), 7.07 d (2H_{Ar}, J = 8.4 Hz), 7.40–7.56 m (3H_{Ar}), 7.79–7.86 m (2H_{Ar}), 7.93 d (2H_{Ar}, J = 8.4 Hz), 9.45 s (1H, NH), 10.78 s (1H, NH). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 14.43 (CH_3, Oct), 22.57 (CH_2, Oct), 25.93 (CH_2, Oct), 29.06 (CH_2, Oct), 29.17 (CH_2, Oct), 29.19 (CH_2, Oct), 31.70 (CH_2, Oct), 68.25 (OCH_2, Oct), 114.37 (2C_{Ar}), 125.74 (C^i_{Ar}), 126.85 (2C_{Ar}), 129.12 (2C_{Ar}), 129.19 (2C_{Ar}), 131.54 (C_{Ar}), 158.45 (C^i_{Ar}), 161.36 (C^i_{Ar}), 166.13 (C=O), 168.37 (C=O). Found, %: C 71.74; H 7.69; N 7.56. $C_{22}H_{28}N_2O_3$. Calculated, %: C 71.71; H 7.66; N 7.60.

2-Hydroxy-*N*'-[(4-octyloxyphenyl)carbonyl] benzohydrazide (2b) was prepared similarly from salicylic acid hydrazide **1b**. Yield 1.56 g (81%), colorless crystals, mp 125–127°C. IR spectrum, ν, cm^{-1}: 3315 (O–H), 3224 (N–H), 1665, 1626 (C=O, amide); 1609, 1595(C=C); 1544 [δ(NH)]; 1502, 1488, 1456; 1303, 1258 [ν_s(Ar–O–C)]; 1181, 1155, 1132 [ν_{as}(Ar–O–C)]; 1065, 1025, 997, 972; 838 [$\delta(C_{Ar}H)$]; 748 [δ(CH)]. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 0.89 t (3H, CH_3, Oct, J = 7.2 Hz), 1.24–1.55 m (10H, CH_2, Oct), 1.66–1.85 m (2H, CH_2, Oct), 4.07 t (2H, OCH_2, Oct, J = 6.6 Hz), 6.93–7.19 m (4H_{Ar}), 7.49 d. d (1H_{Ar}, J_1 = 7.0, J_2 = 7.1 Hz), 7.89–8.0 m (3H_{Ar}), 10.53 s (1H, OH), 10.66 s (1H, NH), 12.01 s (1H, NH). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 14.41 (CH_3, Oct), 22.54 (CH_2, Oct), 25.94 (CH_2, Oct), 29.03 (CH_2, Oct), 29.12 (CH_2, Oct), 29.18 (CH_2, Oct), 31.69 (CH_2, Oct), 68.22 (OCH_2, Oct), 114.65 (2C_{Ar}), 115.04 (C^i_{Ar}), 117.86 (C_{Ar}), 119.49 (C_{Ar}), 124.72 (C^i_{Ar}), 128.72 (C_{Ar}), 129.89 (2C_{Ar}), 134.60 (C_{Ar}), 159.81 (C^i_{Ar}), 162.06 (C^i_{Ar}), 165.55 (C=O), 168.30 (C=O). Found, %: C 68.77; H 7.31; N 7.34. $C_{22}H_{28}N_2O_4$. Calculated, %: C 68.73; H 7.34; N 7.29.

2-Methoxy-*N*'-[(4-octyloxyphenyl)carbonyl] benzohydrazide (2c) was prepared similarly from *o*-methoxybenzoic acid hydrazide **1c**. Yield 1.67 g (84%), colorless crystals, mp 103–104°C. IR spectrum, ν, cm^{-1}: 3258, 3196 (N–H); 1668, 1633 ν(C=O, amide); 1608, 1577 (C=C); 1555 [δ(NH)]; 1505, 1480, 1470, 1326; 1307, 1294, 1248 [ν_s(Ar–O–C)]; 1178, 1116 [ν_{as}(Ar–O–C)]; 1106, 1070, 1045, 1026, 969, 910; 878, 842 [$\delta(C_{Ar}H)$]; 800, 788;751 [δ(CH)]. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 0.90 t (3H, CH_3, Oct, J = 7.2 Hz), 1.27–1.58 m (10H, CH_2, Oct), 1.67–1.85 m (2H, CH_2, Oct), 3.88 s (3H, OCH_3), 4.06 t (2H, OCH_2, Oct, J = 6.7 Hz), 6.94–7.20 m (4H_{Ar}), 7.50 d. d (1H_{Ar}, J_1 = 6.9, J_2 = 7.0 Hz), 7.75 d. d (1H_{Ar}, J_1 = 0.9, J_2 = 6.7 Hz), 7.94 d (2H_{Ar}, J = 8.4 Hz), 10.81 s (1H, NH), 11.93 s (1H, NH). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 14.42 (CH_3, Oct), 22.53 (CH_2, Oct), 25.95 (CH_2, Oct), 29.01 (CH_2, Oct), 29.14 (CH_2, Oct), 29.17 (CH_2, Oct), 31.68 (CH_2, Oct), 56.37 (OCH_3), 68.23 (OCH_2, Oct), 112.58 (C_{Ar}), 114.67 (2C_{Ar}), 121.01 (C_{Ar}), 122.19 (C^i_{Ar}), 129.85 (2C_{Ar}), 130.96 (C_{Ar}), 133.19 (C_{Ar}), 134.62 (C^i_{Ar}.), 157.59 (C^i_{Ar}), 162.07 (C^i_{Ar}), 165.23 (C=O), 168.28 (C=O). Found, %: C 69.37; H 7.62; N 7.02. $C_{23}H_{30}N_2O_4$. Calculated, %: C 69.32; H 7.59; N 7.03.

2-(4-octyloxyphenyl)-5-phenyl-1,3,4-oxadiazole (3a). A solution of 1.47 g (0.004 mol) of benzohydrazide **2a** in 20 mL of thionyl chloride was refluxed during 5 h. Thionyl chloride was distilled off, the reaction mass was cooled down to ambient, and 50 g of crushed ice was added. The precipitate was filtered off and purified by column chromatography on silica gel (0.063–0.200 mm, eluent: ethyl acetate–petroleum ether, 1 : 10) collecting the fraction with R_f 0.70–0.75. The solvent was distilled off, and the residue was recrystallized from isopropanol. Yield 0.99 g (71%), colorless crystals, mp 79–81°C.

IR spectrum, ν, cm^{-1}: 1615, 1607 (C=N); 1583, 1549 (C=C); 1530, 1507; 1443 (N–N); 1424, 1371, 1305; 1261, 1245 [ν_s(Ar–O–C)]; 1118, 1071 [ν_{as}(Ar–O–C)]; 988, 882; 851 [δ(C_{Ar}H)]; 792, 773; 743 [δ(CH)]. UV spectrum, λ_{max}, nm (ε×10^{-4}, L mol^{-1} cm^{-1}, λ_{ex} = 315 nm): isooctane, 242 (0.28), 284 sh (1.50), 295 (1.71), 306 sh (1.41), 320 sh (0.57), λ^{fl}_{max}(φ) 352 (0.81); acetonitrile, 244 (0.80), 282 sh (2.44), 294 (2.73), 306 sh (2.17), 318 sh (0.94), λ^{fl}_{max}(φ) 369 (0.92); DMSO, 299 (1.61), 311 sh (1.38), 324 sh (0.63), λ^{fl}_{max}(φ) 377 (0.73). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 0.93 t (3H, CH_3, Oct, J = 7.2 Hz), 1.20–1.58 m (10H, CH_2, Oct), 1.73–1.91 m (2H, CH_2, Oct), 4.04 t (2H, OCH_2, Oct, J = 6.6 Hz), 7.03 d (2H_{Ar}, J = 8.4 Hz), 7.50–7.58 m (3H_{Ar}), 8.07 d (2H_{Ar}, J = 8.4 Hz), 8.10–8.19 m (2H_{Ar}). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 14.11 (CH_3, Oct), 22.66 (CH_2, Oct), 26.01 (CH_2, Oct), 29.14 (CH_2, Oct), 29.24 (CH_2, Oct), 29.35 (CH_2, Oct), 31.81 (CH_2, Oct), 68.27 (OCH_2, Oct), 114.96 (2C_{Ar}), 116.12 (C$^i_{Ar}$), 124.11 (C$^i_{Ar}$), 126.79 (2C_{Ar}), 128.64 (2C_{Ar}), 129.01 (2C_{Ar}),131.48 (C_{Ar}), 161.98 (C$^i_{Ar}$), 164.05 (C_{Ht}), 164.58 (C_{Ht}). Found, %: C 75.42; H 7.45; N 8.03. $C_{22}H_{26}N_2O_2$. Calculated, %: C 75.40; H 7.48; N 7.99.

2-[5-(4-Octyloxyphenyl)-1,3,4-oxadiazol-2-yl]-phenol (3b). Yield 1.24 g (85%), colorless crystals, mp 77–79°C. IR spectrum, ν, cm^{-1}: 3161 (O–H); 1626, 1614 (C=N); 1593, 1544 (C=C); 1498, 1486; 1455 (N–N); 1426, 1397, 1377; 1302 [ν_s(C–O_{phenol})]; 1257, 1238 [ν_s(Ar–O–C)]; 1181, 1172, 1130 [ν_{as}(Ar–O–C)]; 1090, 1066 [ν_{as}(C–O_{phenol})]; 1034, 999, 972; 836 [δ(C_{Ar}H)]; 751 [δ(CH)]. UV spectrum, λ_{max}, nm (ε×10^{-4}, L mol^{-1} cm^{-1}, λ_{ex} = 325 nm): isooctane, 239 (1.09), 246 (1.19), 279 (3.38), 292 (3.96), 308 sh (3.23), 319 (4.23), 333 (3.35), λ^{fl}_{max}(φ) 358 (0.001), 482 (0.002); dioxane, 292 (3.29), 308 (3.10), 319 (3.82), 332 sh (2.82), λ^{fl}_{max}(φ) 378 (0.002), 483 (0.005); acetonitrile, 247 (1.04), 282 sh (2.56), 291 (2.88), 317 (3.29), 335 sh (2.94), λ^{fl}_{max}(φ) 361 (0.004), 469 (0.001); DMSO, 293 (2.83), 312 (2.60), 334 sh (1.63), λ^{fl}_{max}(φ) 366 (0.32). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 0.87 t (3H, CH_3, Oct, J = 7.2 Hz), 1.23–1.50 m (10H, CH_2, Oct), 1.70–1.83 m (2H, CH_2, Oct), 3.95 t (2H, OCH_2, Oct, J = 6.6 Hz), 6.92–7.00 m (3H_{Ar}), 7.06 d. d (1H_{Ar}, J_1 = 1.1, J_2 = 6.7 Hz), 7.37 d. d (1H_{Ar}, J_1 = 6.7, J_2 = 6.9 Hz), 7.74 d. d (1H_{Ar}, J_1 = 1.0, J_2 = 7.1 Hz), 7.96 d (2H_{Ar}, J = 8.4 Hz), 10.17 s (1H, OH). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 14.11 (CH_3, Oct), 22.67 (CH_2, Oct), 25.94 (CH_2, Oct), 29.14 (CH_2, Oct), 29.25 (CH_2, Oct), 29.36 (CH_2, Oct), 31.83 (CH_2, Oct), 68.28 (OCH_2, Oct), 108.22 (C$^i_{Ar}$), 114.97 (2C_{Ar}), 115.27 (C$^i_{Ar}$), 117.11 (C_{Ar}), 119.75 (C_{Ar}), 126.31 (C_{Ar}), 128.64 (2C_{Ar}), 133.27 (2C_{Ar}), 157.41 (C$^i_{Ar}$), 162.23 (C$^i_{Ar}$), 163.12 (C_{Ht}), 163.55 (C_{Ht}). Found, %: C 72.16; H 7.14; N 7.68. $C_{22}H_{26}N_2O_3$. Calculated, %: C 72.11; H 7.15; N 7.64.

2-(2-Methoxyphenyl)-5-(4-octyloxyphenyl)-1,3,4-oxadiazole (3c). Yield 1.20 g (78%), colorless crystals, mp 59–60°C. IR spectrum, ν, cm^{-1}: 1628, 1612 (C=N); 1595, 1557 (C=C); 1501, 1489; 1447 (N–N); 1422, 1327, 1298, 1273; 1248, 1231 [ν_s(Ar–O–C)]; 1173, 1168 [ν_{as}(Ar–O–C)]; 1075, 1016, 923; 860, 831 [δ(C_{Ar}H)]; 758 [δ(CH)]. UV spectrum, λ_{max}, nm (ε×10^{-4}, L mol^{-1} cm^{-1}, λ_{ex} = 325 nm): dioxane, 291 (3.11), 306 (2.74), 316 sh (2.33), 330 sh (1.03), λ^{fl}_{max}(φ) 366 (0.88); acetonitrile, 239 (0.88), 244 (0.98), 278 sh (2.47), 289 (2.57), 308 (2.22), 329 (0.87), λ^{fl}_{max}(φ) 361 (0.85); DMSO, 284 sh (3.42), 292 (3.48), 320 sh (2.55), 333 (1.21), λ^{fl}_{max}(φ) 367 (0.92). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 0.96 t (3H, CH_3, Oct, J = 7.2 Hz), 1.12–1.63 m (10H, CH_2, Oct), 1.76–1.98 m (2H, CH_2, Oct), 3.90–4.25 m (5H, OCH_3, OCH_2, Oct), 6.90–7.25 m (3H_{Ar}), 7.33 d. d (1H_{Ar}, J_1 = 1.1, J_2 = 7.0 Hz), 7.58 d. d (1H_{Ar}, J_1 = 7.0, J_2 = 7.1 Hz), 7.98–8.26 (3H_{Ar}). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 14.11 (CH_3, Oct), 22.67 (CH_2, Oct), 25.94 (CH_2, Oct), 29.14 (CH_2, Oct), 29.25 (CH_2, Oct), 29.36 (CH_2, Oct), 31.83 (CH_2, Oct), 56.37 (OCH_3), 68.28 (OCH_2, Oct), 108.22 (C$^i_{Ar}$), 114.97 (2C_{Ar}), 115.27 (C$^i_{Ar}$), 117.11 (C_{Ar}), 119.75 (C_{Ar}), 126.31 (C_{Ar}), 128.64 (2C_{Ar}), 133.27 (C_{Ar}), 157.41 (C$^i_{Ar}$), 162.23 (C$^i_{Ar}$), 163.12 (C_{Ht}), 163.55 (C_{Ht}). Found, %: C 72.63; H 7.40; N 7.39. $C_{23}H_{28}N_2O_3$. Calculated, %: C 72.60; H 7.42; N 7.36.

Bis{2-[5-(4-octyloxyphenyl)-1,3,4-oxadiazol-2-yl]-phenolato}cadmium(II) (4). 0.27 g (0.001 mol) of cadmium acetate dihydrate in 5 mL of methanol was added at stirring and room temperature to a solution of 0.73 g (0.002 mol) of oxadiazole **3b** in 15 mL of methanol. The mixture was refluxed during 5 h and then cooled down to ambient. The precipitate was filtered off, washed with methanol (2×30 mL), dried in air, and recrystallized from methanol (300 mL). Yield 0.53 g (63%), colorless crystals, mp 285–287°C. IR spectrum, ν, cm^{-1}: 1612 (C=N); 1553, 1532 (C=C); 1504, 1480; 1435 (N–N); 1342; 1303 [ν_s(C–O_{phenol})]; 1258 [ν_s(Ar–O–C)]; 1102, 1126, 1176 [ν_{as}(Ar–O–C)]; 1065, 1025, 998, 970, 906; 837 [δ(C_{Ar}H)]; 750 [δ(CH)]. UV spectrum, λ_{max}, nm (ε×10^{-4}, L mol^{-1} cm^{-1}, λ_{ex} = 370 nm): acetonitrile, 280 sh (2.75), 292 (3.02), 304 (2.51), 319 (2.29), 331 (1.81), 372 (0.88), λ^{fl}_{max}(φ) 432 (0.28); DMSO, 293 (2.46), 305 (2.19), 322 (1.45), 335 (1.15), 373 (1.34), λ^{fl}_{max}(φ) 443

(0.35). ^{1}H NMR spectrum (DMSO-d_6, 90°C) δ, ppm: 0.88 t (3H, CH_3, Oct, J = 7.2 Hz), 1.25–1.37 m (8H, CH_2, Oct), 1.41–1.47 m (2H, CH_2, Oct), 1.72–1.79 m (2H, CH_2, Oct), 4.09 t (2H, OCH_2, Oct, J = 6.6 Hz), 6.47 d. d (1H_{Ar}, J_1 = 7.4, J_2 = 7.5 Hz), 6.71 d. d (1H_{Ar}, J_1 = 1.2, J_2 = 7.6 Hz), 7.11 d (2H_{Ar}, J = 8.4 Hz), 7.19 d. d (1H_{Ar}, J_1 = 7.4, J_2 = 7.6 Hz), 7.73 d. d (1H_{Ar}, J_1 = 1.1, J_2 = 7.5 Hz), 7.96 d (2H_{Ar}, J = 8.4 Hz). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 13.18 (CH_3, Oct), 21.41 (CH_2, Oct), 24.90 (CH_2, Oct), 27.98 (CH_2, Oct), 28.08 (CH_2, Oct), 28.11 (CH_2, Oct), 30.62 (CH_2, Oct), 67.72 (OCH_2, Oct), 107.36 (C^i_{Ar}), 115.03 (2C_{Ar}), 115.50 (C^i_{Ar}), 127.73 (C_{Ar}), 127.91 (2C_{Ar}), 132.76 (C_{Ar}), 160.49 (C^i_{Ar}), 161.15 (C_{Ar}), 161.25 (C_{Ar}), 163.12 (C^i_{Ar}), 165.48 (C_{Ht}), 176.96 (C_{Ht}). Found, %: C 62.38; H 6.11, N 6.70; Cd 13.07. $C_{44}H_{50}CdN_4O_6$. Calculated, %: C 62.67; H 5.98; N 6.64; Cd 13.33.

IR spectra (Vaseline oil, thin film) were recorded using a Varian Excalibur 3100 FT-IR spectrometer. ^{1}H [250 (**2**, **3**), 600 MHz (**4**)] and ^{13}C [63 (**2**, **3**), 151 MHz (**4**)] NMR spectra were recorded using Bruker DPX-250 and Bruker Avance-600 instruments. Absorption and fluorescence spectra were recorded using a Cary Scan 100 spectrophotometer and Cary Eclipse spectrofluorimeter, respectively. Quantum yields of fluorescence were determined using a solution of anthracene in acetonitrile as reference [12].

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CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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