in each case was prepared from equal volumes of absolute ethanol and either distilled water or 4N sulfuric acid. Immediately prior to use the samples of stilbene and 4-dimethylaminostilbene were purified by chromatography on alumina followed by recrystallization from ethanol thereby, ensuring that any traces of the *cis* isomers were removed.

Department of Organic Chemistry
University of Adelaide
South Australia, Australia

Liquid Scintillators. XII. Absorption and Fluorescence Spectra of 2,5-Diaryl-1,3,4-oxadiazoles[1]

Donald G. Ott, Vernon N. Kerr, F. Newton Hayes, and Elizabeth Hansbury

Received November 6, 1959

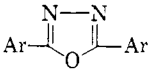
The importance of spectral properties of scintillators has been outlined,[2,3] at which time the absorption and emission spectra of a variety of aryl-substituted oxazoles were reported. Similar data have been obtained for another important class of liquid scintillator solutes, the 1,3,4-oxadizaoles. The synthesis[4] of these compounds and evaluation as liquid scintillator solutes[5] have been reported previously. Two new pyridyl derivatives are described in the Experimental.

The absorption and fluorescence data are presented in Table I; the mean wave length, $\bar{\lambda}$, is that wave length which bisects the area under the fluorescence spectrum.

The effect of an oxadiazole nucleus on the spectrum of an aromatic system is very similar to that of a p-phenylene group. p-Terphenyl (λ_{max} 280, ϵ 2.5 × 10^4), p-quaterphenyl (λ_{max} 300, ϵ 3.9 × 10^4), and p-quinquephenyl (λ_{max} 310, ϵ 6.3 × 10^4)[6] may be compared with the five analogous oxadiazoles having the equivalent number of rings.

TABLE I

ABSORPTION AND FLUORESCENCE SPECTRAL DATA[a]



Ar	Ar′	Absorption			Fluorescence	
		λ_{max}^{abs}	$\epsilon \times 10^{-4}$	λ_{max1}^{fl}	λ_{max2}^{fl}	$\bar{\lambda}$
C_6H_5	C_6H_5	282	2.6	336	350	360
C_6H_5	4-$C_6H_5C_6H_4$	300[b]	4.5	364	380	388
C_6H_5	1-$C_{10}H_7$	313	1.8	372	392	392
C_6H_5	2-$C_{10}H_7$	310	2.7	364	—	380
C_6H_5	2-Furyl	292	3.3	364	—	372
C_6H_5	2-Thienyl	298	2.4	373	—	388
C_6H_5	3-Pyridyl	285	2.3	355	—	362
C_6H_5	4-Pyridyl	284	2.5	335	353	360
p-$CH_3OC_6H_4$	4-$C_6H_5C_6H_4$	308	4.0	372	390	394
p-$CH_3OC_6H_4$	1-$C_{10}H_7$	317	2.3	380	396	402
p-$CH_3OC_6H_4$	2-$C_{10}H_7$	308	3.2	366	382	386
p-$CH_3C_6H_4$	p-$CH_3C_6H_4$	289	3.1	342	354	366
p-$CH_3OC_6H_4$	p-$CH_3OC_6H_4$	301	3.3	356	370	380
p-FC_6H_4	p-FC_6H_4	283	2.4	335	350	358
p-ClC_6H_4	p-ClC_6H_4	294	3.2	344	362	370
p-BrC_6H_4	p-BrC_6H_4	297	3.6	347	360	374
p-IC_6H_4	p-IC_6H_4	303	3.7	344	—	382
4-$C_6H_5C_6H_4$	4-$C_6H_5C_6H_4$	313[b]	6.1	378	396	396
$C_6H_5CH{=}CH$	$C_6H_5CH{=}CH$	331	3.6	406	422	442
2-Furyl	2-Furyl	297	2.6	355	370	378
2-Thienyl	2-Thienyl	313	2.4	377	390	420
1-$C_{10}H_7$	1-$C_{10}H_7$	335	2.3	392	408	412
2-$C_{10}H_7$	2-$C_{10}H_7$	332	3.3	370	388	388
5,5-Diphenyl-2,2′-bi-1,3,4-oxadiazole		298[b]	4.0	354	370	378
2,2′-p-Phenylenebis(5-phenyl-1,3,4-oxadiazole)		315[c]	4.8	373	390	392

[a] Wave lengths are in mu; the solvent was cyclohexane for absorption and toluene for fluorescence unless otherwise indicated. [b] Solvent was 2% chloroform in cyclohexane. [c] Solvent was chloroform; a band at 325 mu, ϵ 4.8 × 10^4, is also present.

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[1] Work performed under the auspices of the U. S. Atomic Energy Commission.

[2] D. G. Ott, F. N. Hayes, E. Hansbury, and V. N. Kerr, *J. Am. Chem. Soc.*, **79**, 5448 (1957).

[3] R. K. Swank, W. L. Buck, F. N. Hayes, and D. G. Ott, *Rev. Sci. Instr.*, **29**, 279 (1958).

[4] F. N. Hayes, B. S. Rogers, and D. G. Ott, *J. Am. Chem. Soc.*, **77**, 1850 (1955).

[5] F. N. Hayes, D. G. Ott, and V. N. Kerr, *Nucleonics*, **13**, No. 12, 38 (1955).

[6] A. E. Gillam and D. H. Hey, *J. Chem. Soc.*, **1939**, 1170.

Fluorescence and absorption maxima of the oxadiazoles occur at shorter wave lengths than for the corresponding oxazoles. Substituent groups influence the maxima in essentially the same manner for both types of compounds, and thus the discussions presented previously regarding correlation of spectra with structure of the oxazoles[2] apply, qualitatively, to the 1,3,4-oxadiazoles.

EXPERIMENTAL[7]

The following compounds were prepared by the procedures given previously[4]:

1-Benzoyl-2-nicotinoylhydrazine, m.p. 234–234.5°, after recrystallization from ethanol.

Anal. Calcd. for $C_{13}H_{11}N_3O_2$: C, 64.72; H, 4.60. Found: C, 64.69; H, 4.56.

3-[5-Phenyl-2-(1,3,4-oxadiazolyl)]pyridine, m.p. 121.5–122°, white needles from toluene-ligroin.

Anal. Calcd. for $C_{13}H_9N_3O$: C, 69.94; H, 4.06; N, 18.83. Found: C, 70.03; H, 4.24; N, 18.38.

1-Benzoyl-2-isonicotinoylhydrazine, m.p. 232–233.5°, white needles from toluene.

Anal. Found for $C_{13}H_{11}N_3O_2$: C, 64.77; H, 4.80.

4-[5-Phenyl-2-(1,3,4-oxadiazolyl)]pyridine, m.p. 142–143°, white needles from toluene.

Anal. Found for $C_{13}H_9N_3O$: C, 70.16; H, 3.98; N, 18.82.

Fluorescence and Absorption Spectra were obtained as described earlier.[2]

Acknowledgment. The authors are grateful for the technical assistance of Mrs. Ruth Lier.

BIOMEDICAL RESEARCH GROUP
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, N. M.

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[7] Melting points are uncorrected. Microanalyses are by Micro-Tech Laboratories, Skokie, Illinois.