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United States Patent [19]

Nakaya et al.

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[54] **ORGANIC EL ELEMENT**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] **H05B 33/12**

[52] **U.S. Cl.** **428/411.1**; 313/504; 313/506; 428/457; 428/690; 428/704; 428/917

[58] **Field of Search** 428/690, 704, 428/9, 7, 457, 411.1; 313/504, 506

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,720,432	1/1988	VanSlyke et al.	428/457
5,061,569	10/1991	VanSlyke et al.	428/457
5,085,946	2/1992	Saito et al.	428/690
5,338,634	8/1994	Ueda	430/59
5,405,709	4/1995	Littman et al.	428/690

FOREIGN PATENT DOCUMENTS

0 508 562	10/1992	European Pat. Off. .
0 510 541	10/1992	European Pat. Off. .
0 650 955	5/1995	European Pat. Off. .

(List continued on next page.)

OTHER PUBLICATIONS

Helv. Chim. Acta, vol. 7, 1924, pp. 789–799.

Extended Abstracts of the 39th Spring Meeting, 1992 of The Japan Society of Applied Physics and Related Societies, No. 3, 28p–Q–8, "Characteristics of the Organic EL Device Doped with Rubrene", H. Kanai, et al., p. 1036.

Preprint of Workshop 92 of the Japanese Research Association for Organic Electronics Materials (JOEM), 1992, Sato, et al., pp. 31–39.

Extended Abstracts of 54th Autumn Meeting, 1993 of The Japan Society of Applied Physics, No. 3, 29p–ZC–7, "Characteristics of Organic EL Cells Based on Doped Hole Transport Layer", T. Fujii, et al., p. 1124.

Caoutchoucs & Plastiques Sommaire, No. 561, Jun. 1976, pp. 57–59, G. Friedmann, et al., "Polymerisation De L'Isoprene Par Catalyse Ziegler–Matta En Presence De Diamines Aromatiques".

Chemical Abstract Society, 1993, RN: 122909–77–7 and 66989–45–5.

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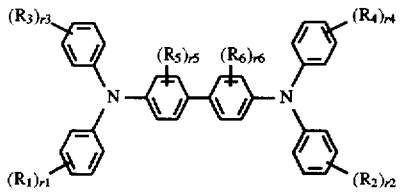
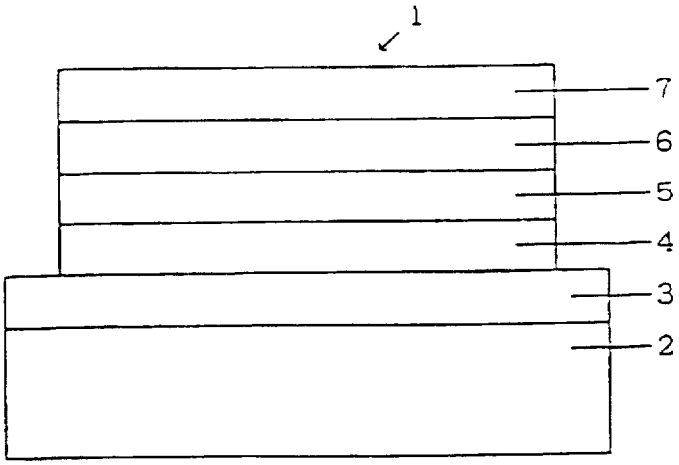
[57] **ABSTRACT**

Tetraaryldiamie derivatives of formula (1) are used in organic EL elements.

(1)



R_1, R_2, R_3, and R_4 represent aryl, alkyl, alkoxy, aryloxy, amino or halogen, at least one of R_1 to R_4 is an, aryl group, r1, r2, r3, and r4 are 0 or an integer of 1 to 5, the sum of r1 to r4 is at least 1, R_5 and R_6 represent alkyl, alkoxy, amino or halogen, r5 and r6 are 0 or an integer of 1 to 4. The inventive compounds have high m.p. and high Tg and can be evaporated to deposit tranparent smooth thin films of quality which maintain a stable amorphous state are room temperature over a long term. Organic EL elements using the invertive compound in an organic compound layer, typically a hole injecting and transporting layer thereof provide uniform plane light emission and maintain a high intensity of luminescence in a stable manner over a long term. Thus the elements are fully durable and reliable.

38 Claims, 11 Drawing Sheets