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(54) **SYNTHESIS OF PERYLENE-PORPHYRIN BUILDING BLOCKS AND POLYMERS THEREOF FOR THE PRODUCTION OF LIGHT-HARVESTING ARRAYS**

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**Related U.S. Application Data**

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(52) **U.S. Cl.** ..... **136/263**; 136/252; 136/256; 257/40; 257/431; 429/111; 252/501.1; 546/37; 546/38; 549/232; 540/145

(58) **Field of Search** ..... 136/263, 252, 136/256; 257/40, 431; 429/111; 252/501.1; 546/38, 37; 549/232; 540/145

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,539,100 A 7/1996 Wasielewski et al.  
5,808,073 A \* 9/1998 Bohm et al. .... 546/39  
6,407,330 B1 \* 6/2002 Lindsey et al. .... 136/263  
6,420,648 B1 \* 7/2002 Lindsey ..... 136/263

6,441,174 B1 \* 8/2002 Hendi ..... 546/37  
6,464,902 B1 \* 10/2002 Gaynor et al. .... 252/600  
6,559,374 B2 \* 5/2003 Lindsey et al. .... 136/263  
6,596,935 B2 \* 7/2003 Lindsey et al. .... 136/263  
6,603,070 B2 \* 8/2003 Lindsey et al. .... 136/263  
2002/0185173 A1 \* 12/2002 Lindsey et al. .... 136/263  
2003/0111108 A1 \* 6/2003 Lindsey et al. .... 136/263  
2004/0254383 A1 \* 12/2004 Yu et al. .... 548/402

**FOREIGN PATENT DOCUMENTS**

JP 6-252379 A \* 9/1994  
JP 9-18039 \* 1/1997  
WO WO 02/08230 1/2002

**OTHER PUBLICATIONS**

Schneider et al, "Hybrid Materials Doped with Covalently Bound Perylene Dyes through the Sol-Gel Process," Chem. Mater., vol. 12, pp. 352-362, Feb. 4, 2000.\*

(Continued)

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(57) **ABSTRACT**

The present invention provides methods, compounds, and compositions for the synthesis of light harvesting arrays, such arrays comprising: (a) a first substrate comprising a first electrode; and (b) a layer of light harvesting rods electrically coupled to said first electrode, each of said light harvesting rods comprising a polymer of Formula I:



wherein m is at least 1; X<sup>1</sup> is a charge separation group, and X<sup>2</sup> through X<sup>m+1</sup> are chromophores. At least one of X<sup>2</sup> through X<sup>m+1</sup> has at least one perylene group coupled thereto.

**81 Claims, 4 Drawing Sheets**

