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Organic Electronics – Retrospective and Outlook

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In 1986-89, together with colleagues at Kodak Research Laboratories, I published three papers[1-3] which have been credited with the rebirth of a field now known as organic electronics. The first paper discloses a thin-film, organic photovoltaic (OPV) cell capable of achieving a benchmark efficiency of 1%. The other two papers describe an electroluminescent diode (now commonly known as OLED, organic light emitting diode), which demonstrated an efficiency greater than 1% in addition to being tunable in color via a doping technique. These relatively novel optoelectronic devices, which are based on organic semiconductors with characteristically low carrier mobilities, have in common a bi-layer, heterojunction structure which is the key to achieving outstanding device performance. The heterojunction structure is comprised of a hole-transport (p-type) layer and an electron-transport (n-type) layer, where the HOMO and LUMO energy levels of the two layers can be designed to produce the desired pn heterojunctions for charge generation in OPV cells or recombination in OLEDs. After decades of research, development, and manufacturing efforts on organic electronics, OLED stands out as the only technology that has achieved commercial success in being widely adopted in today's consumer products and acclaimed as the next-generation display technology.

In this review, I will trace the development of OLED display technology from its discovery to its commercialization, and offer an assessment of its future outlook in view of the display industry's competitive landscape.

1. C.W. Tang, Appl. Phys. Lett. 48, 183(1986)
2. C.W. Tang and S.A. VanSlyke, Appl. Phys. Lett. 51, 913 (1987)
3. C.W. Tang, S.A. VanSlyke and C.H.Chen, J. Appl. Phy. 65, 3610 (1989)