

Organic Light Emitting Diode – A review

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Organic Light Emitting Diode (OLED) is a major optoelectronics technology today. It is the first light-emitting device based solely on organic semiconductors that has achieved a performance in efficiency and color fidelity matching or even exceeding those of the conventional inorganic III-V LED. For applications, OLED as a thin-film device offers important advantages over the crystalline LED in terms of manufacture scalability. Whereas the growth of LED is generally limited to small-size wafers up to 4" and requires a high temperature for processing, thin-film OLED is readily produced on large-area glass plates measuring in square meters at or near room temperature. For assembling or patterning to form pixel arrays over a large area, unlike LED where the array resolution is generally limited to 100 ppi (pixel per inch) by a pick-and-place assembly method, OLED can be monolithically patterned to achieve a resolution well exceeding 1000 ppi. For these reasons, they both found their ubiquitous applications - LED for general lighting, and OLED for high-resolution displays of various sizes. Furthermore, for display applications OLED, being self-emissive, can achieve extremely low black levels far beyond what is achievable by the liquid crystal display (LCD) - the currently dominant display technology. As a result, OLED display is naturally superior to LCD in picture quality, and in conjunction with a flexible form factor, it is being adopted for applications beyond smartphones and TVs to laptops and wearables such as headsets for virtual reality.

In this review I will trace the development of OLED from its serendipitous discovery in late 1970s at the Kodak Research Laboratory to its evolution as a premium display technology in recent years. I will highlight some major scientific advances in OLED materials and devices that led to nearly unity quantum efficiency in light emission and a useful lifetime in tens of thousands of hours, along with an assessment of the future of OLED displays in view of the industry's competitive landscape.