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Direct printing of (organic) light emitting devices on textile

Abstract

Smart textiles with light-emitting properties open a whole new world of innovative textile applications. Besides the use as protective or safety clothing for road workers, police and fire departments, these light-emitting textiles can also be used as indoor and outdoor design. Lighting wallpaper or tiles and textile banners and flags used for advertisement are among this wide variety of applications. Even healthcare applications, such as light therapy are within reach.

To achieve light-emitting properties on textiles, (organic) light emitting devices are printed (directly) onto textile substrates. In this work two different approaches are followed: electroluminescent devices (EL devices) and organic light emitting devices (OLEDs). The first approach shows that direct printing of light emitting devices on textiles is possible. These EL devices however still have some downsides such as a high energy consumption and a low flexibility and drapability, due to the thickness (100µm) of the layers. The OLEDs, that form the second approach, are more difficult to apply directly on textiles but are the route ahead for light emitting wearables [1]. These OLEDs are built up out of 4 to 6 very thin layers ending up with a device stack of maximum 0.5 micrometer and therefore maintain the flexibility and drapability of the textile substrate. Further they have a high brightness and a very low power consumption. To protect these devices from fast degradation from contact with oxygen or water vapour, an encapsulation layer will be applied on top [2].

As the roughness of most textile substrates is in the micrometer range, and the thickness of the encapsulation layers and the different layers in the OLED stack are in the nanometer range, it is first important to investigate the influence of different smoothing layers, among which polyurethane (PU), acrylate and polymethylmethacrylate (PMMA), on their surface properties. As a next step, encapsulation layers will be applied using plasma techniques and their transparency, chemical composition and barrier properties for oxygen and water vapour will be measured. On top of this encapsulation, the OLED stack will be deposited. By using spin coating and evaporation techniques, OLEDs will be fabricated and their resolving light output and luminous efficacy will be measured. To finalize the complete stack, a last encapsulation is applied and the final properties of the device are measured and compared with reference devices on glass substrates. It is shown in this work that light emitting devices can be printed (directly) onto a textile carrier to be used in a wide range of applications.

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