Mater. Res. Soc. Symp. Proc. Vol. 1511 © 2012 Materials Research Society
DOI: 10.1557/opl.2012.1711

Fabrication of Micro-OLEDs by Room-temperature Curing Nanocontact-print Lithography Using DLC Molds

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ABSTRACT

The microfabrication technologies for organic light-emitting devices (OLEDs) are essential to the fabrication of the next generation of light-emitting devices. The micro-OLEDs fabricated by room-temperature curing nanoimprint lithography (RTC-NIL) using diamond molds have been investigated. However, light emissions from 10 μm-square-dot OLEDs fabricated by the RTC-NIL method have not been uniform. Therefore, we proposed the fabrication of micro-OLEDs by room-temperature curing nanocontact-print lithography (RTC-NCL) using the diamond-like carbon (DLC) mold. The DLC molds used in RTC-NCL were fabricated by an electron cyclotron resonance (ECR) oxygen ion shower with polysiloxane oxide mask in electron beam (EB) lithography technology. The mold patterns are square and rectangle dots which has 10 μm-width, 10 μm-width and 50 μm-length, respectively. The height of the patterns is 500 nm. The DLC molds were used to form the insulating layer of polysiloxane in RTC-NCL. We carried out the RTC-NCL process using the DLC mold under the following optimum conditions: 0.1 MPa-pressure for coating DLC mold with polysiloxane film, 2.1 MPa-pressure for transferring polysiloxane from DLC mold pattern to indium tin oxide (ITO) glass substrate. We deposited N,N'-Diphenyl -N,N'-di (m-tolyl)benzidine (TPD) [40 nm-thickness] as hole transport layer / Tris(8-quinolinolato)aluminum (Alq_3) [40 nm-thickness] as electron transport layer / Al [200 nm-thickness] as cathode on ITO glass substrate as anode in this order. We succeeded in formation of the insulating layer with square and rectangle dots which has 10 μm-width, 10 μm-width and 50 μm-length, and operation of micro-OLEDs by RTC-NIL using DLC molds.

INTRODUCTION

Organic light-emitting devices (OLEDs) are expected to be used in next-generation display screens replacing liquid crystal display (LCD). The microfabrication technologies of OLEDs are an important step in the development of the display industry. In the past few years there has been an extensive effort to investigate the micropatterning technologies for OLEDs [1 - 5]. In many cases, micropatterning technologies of OLEDs are prepared by micro- and nano-fabrication