Characterization of local emission from organic EL device induced by STM light emission spectroscopy

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Scanning tunneling microscopy-induced light emission (STM-LE) is the method that enables us to study the optical properties in the nano-sized region of conductive materials. Many works have been carried out for various adsorbed organic molecules on metal substrates such as Au, Ag and Cu. But studies of STM-LE for organic multilayer structures have not been enough, in spite of their practical importance. In this study, we practically performed STM-LE measurement on multilayered organic light emitting devices (OLED), which included dopant molecules in their emitting layer, in order to evaluate the capability of STM-LE for application.

The measurements were performed in ultrahigh vacuum at room temperature. We used an electropolished PtIr as a STM tip. The light emitted from tunnel junction was focused onto an entrance edge of an optical fiber, and introduced to a monochromater and detected by a liquid Nitrogen cooled high-sensitive CCD. The organic films were prepared by vacuum deposition on the Au (111). Film thickness of each layer was monitored using a Quartz crystal oscillator. The emitted layer used in this study was consisted of Alq_3 molecular layer with dopant Rubrene molecules. The emitted layer was deposited on TPD molecular layers used as hole transport layer on the substrate. The emitting layer of organic multilayer was fabricated by co-deposition of Alq_3 molecules and Rubrene molecules in vacuum. The mixture ratio of Alq_3 : Rubrene was 20 : 1.

Figure 1 (a) and (b) show 2D mapping of light emission intensity from the OLED structure with emission wavelength of Alq_3 and Rubrene molecules, respectively. These results indicate that the achieved spatial resolution of the STM-LE measurement was about 10 nm, and we could characterize local light emission intensity from OLEDs by using this method. Especially, since light emission intensity from Rubrene molecules was completely quenched at several regions (Fig. 1(b)), Rubrene molecules seemed to aggregate together in organic emitting layer. The details including the discussion of the light emitting mechanism will be discussed at the conference.

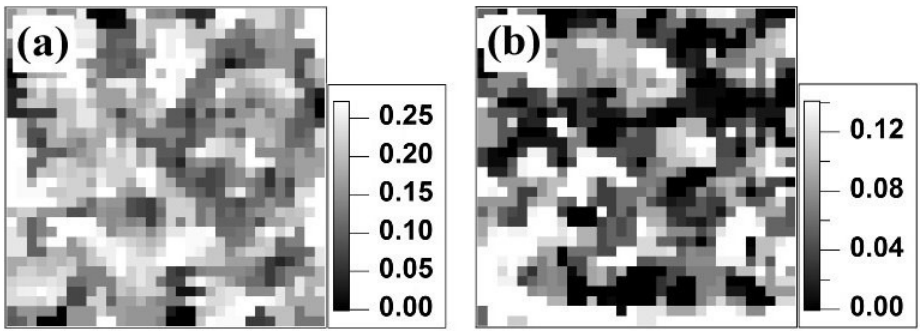

Fig. 1. 2D mapping of light emission intensity from (a) Alq_3 (λ=530±20 nm), and (b) Rubrene molecules (λ=600±30 nm), respectively. (scan width:1000×1000 nm^2)