Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Localized Surface Plasmons Resonance on Emission Color Change for Organic Light Emitting Diodes

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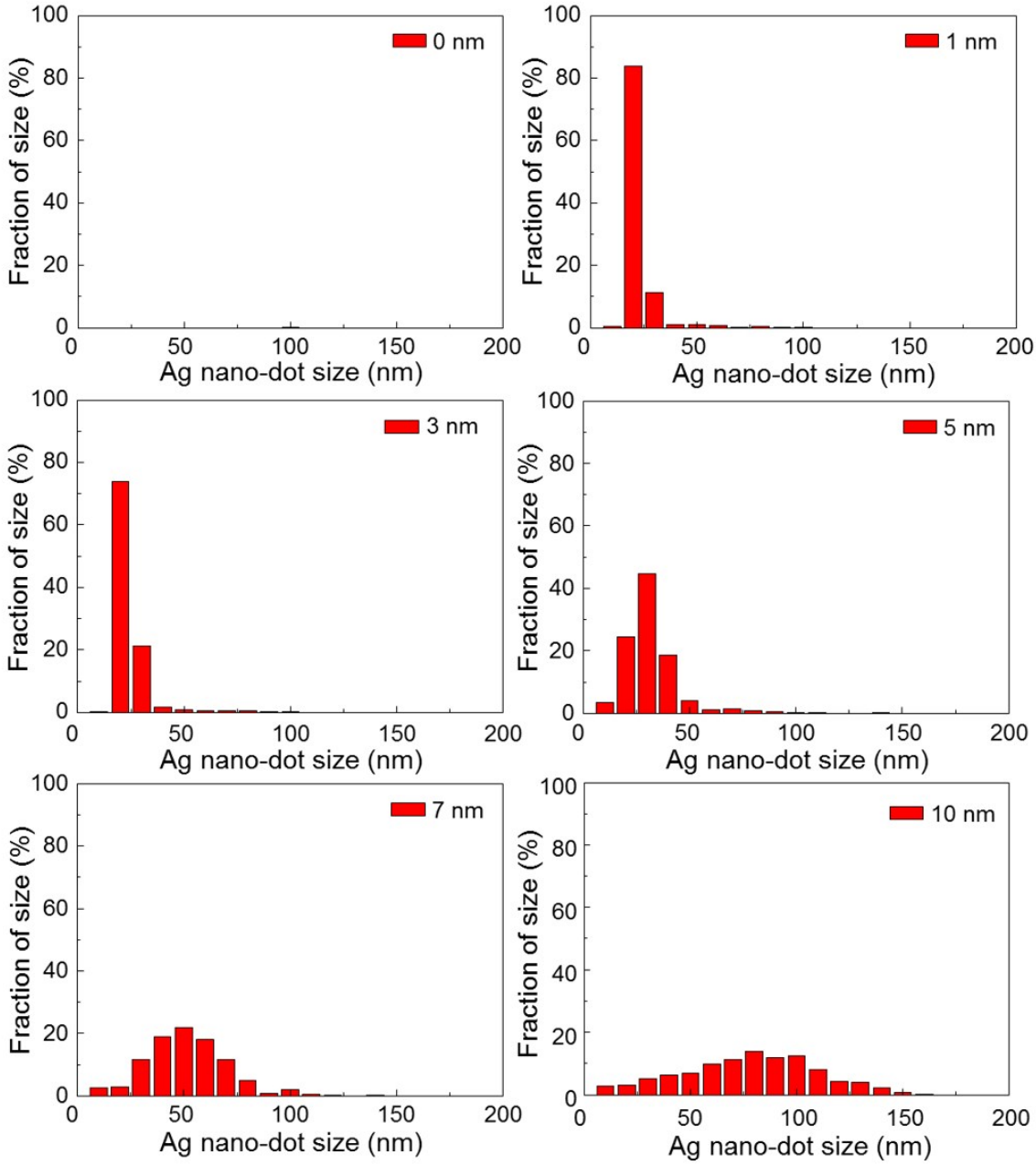

Fig. S1 Size distribution histogram of Ag nano-dots on the glass/ITO

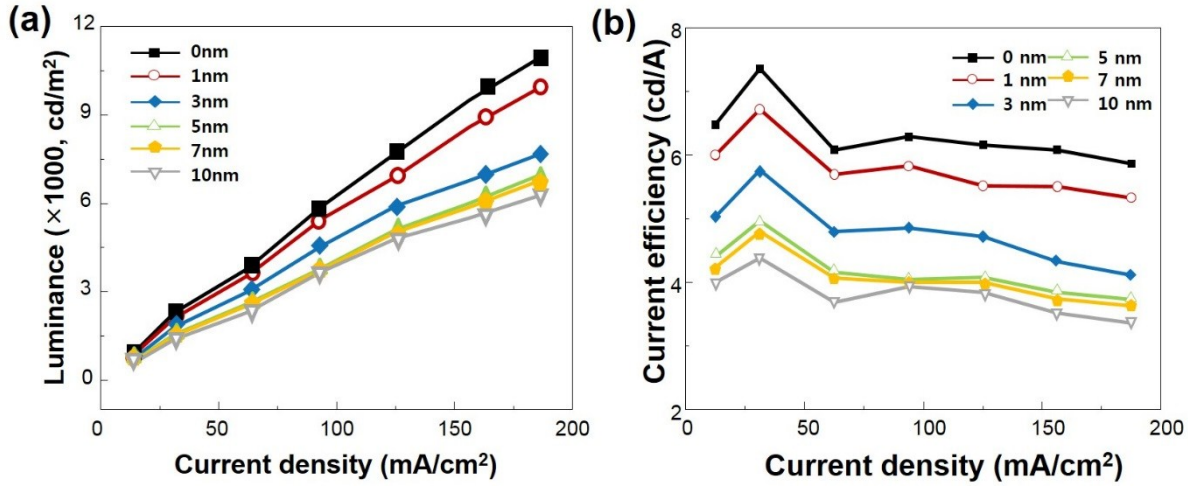

Fig. S2 (a) Luminance-current density (*L-J*) characteristics of Ag nano-dot embedded OLEDs (b) Current density-current efficiency

Figure S2b shows the current efficiency-current density characteristics of the devices. OLEDs without Ag nano-dots have higher current efficiency than that with Ag nano-dots. The current efficiency at 62.5 mA/cm^2 was calculated to be 6.08 cd/A without Ag nano-dots, but it decreased to 4.16 cd/A with Ag nano-dots (T_{Ag} = 5 nm).

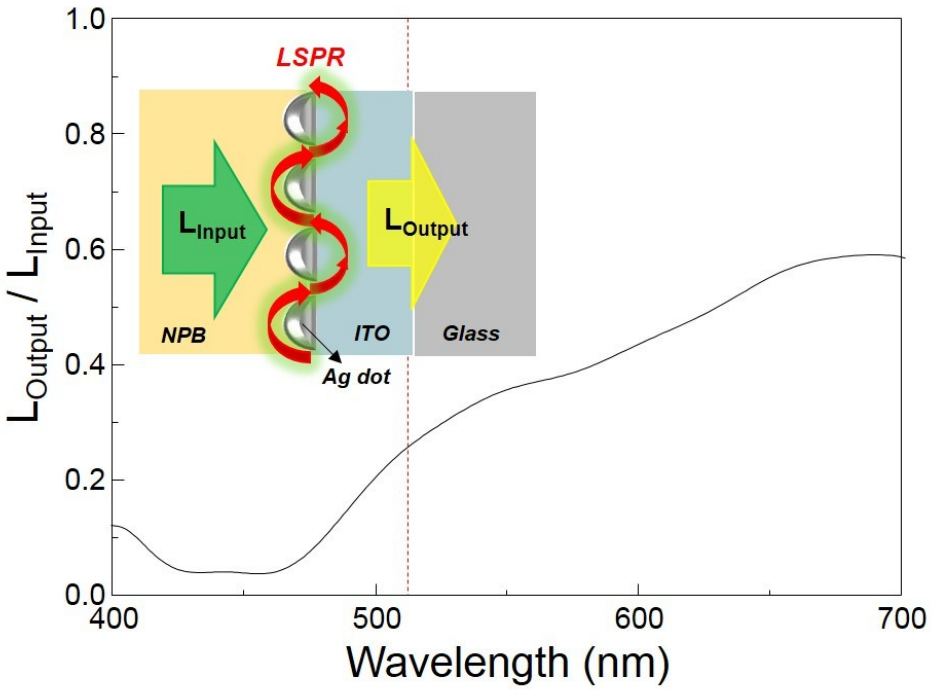

Fig. S3 Calculated the output power/input power ratio as a function of wavelength using FDTD simulation

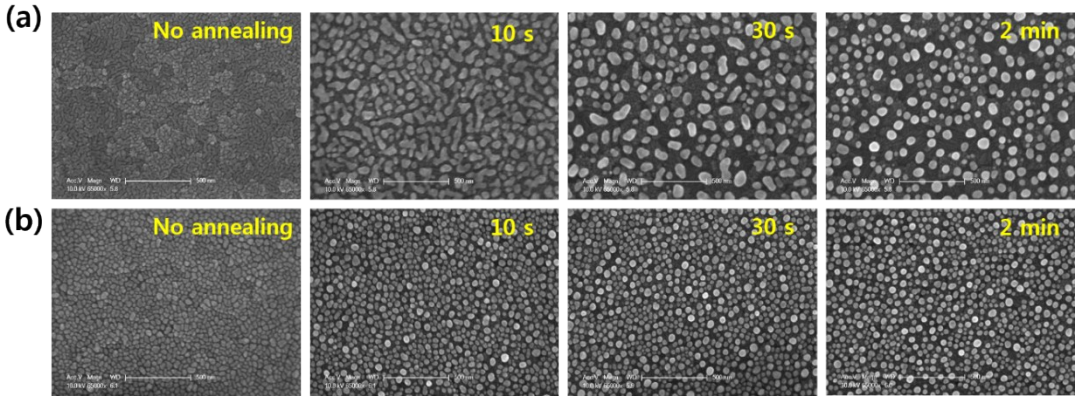

Fig. S4 SEM images of glass/ITO/Ag nano-dots samples. Two structures, (a) without plasma and (b) with plasma on the ITO layer were treated before Ag deposition. (T_{Ag} = 10 nm, plasma power: 150 W, process time: 1 min, process pressure: 100 mtorr, process time: no annealing, 10 s, 30 s, 2 min)

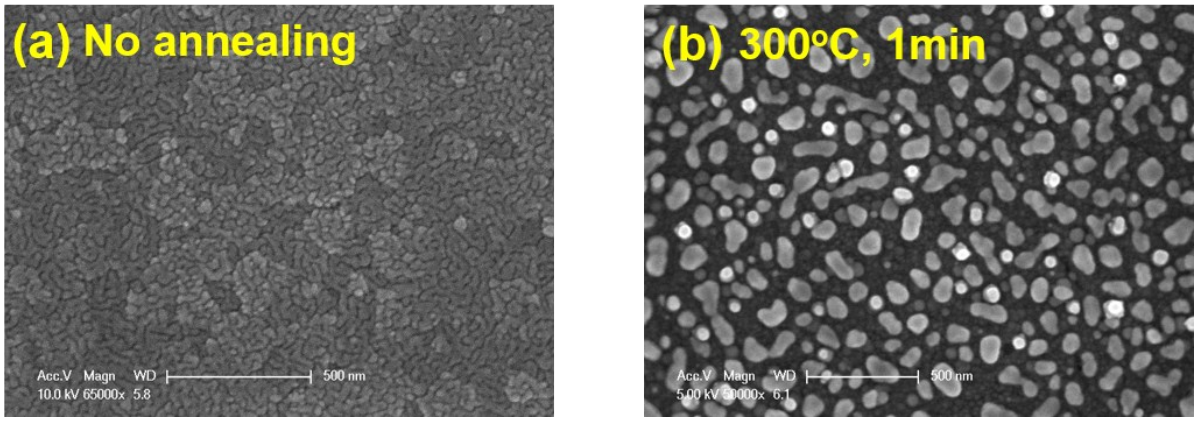

Fig. S5 SEM images of glass/ITO/Ag nano-dots samples as a function of plasma process pressure. (T_{Ag} = 10 nm, plasma power: 150 W, process time: 10 s)

It is difficult to precisely control the size and spacing of Ag nano-dots using a thermal annealing due to the easy migration of Ag atoms on ITO, originating from the difference of surface energy mismatch between Ag and ITO layer [Ref 1, 2]. Controlling the surface energy of ITO layer could be a key to control the size and spacing of Ag nano-dots. Two kinds of samples were prepared. One was as-received ITO and the other was O_2 plasma-treated one. 10 nm-thick Ag films were deposited on both samples using a thermal evaporator. Both samples were annealed at 300 °C by a rapid thermal annealing under vacuum ambient. The size of Ag-nano-dot decreased with the annealing time in the as-received sample (Fig. S4a), but no distinct

change was found in the O_2-plasma-treated one, as shown in Fig. S4b. This is due to that the plasma treatment played a role in increasing the surface energy and thereby suppressing the migration of Ag atoms. The Ag nano-dot size could be controlled by changing the process pressure of plasma. The size was reduced, shown in Fig. S5, as the process pressure reduced due to the increase of kinetic energy of plasma [Ref 3].

Reference

[1] H. Kang, S. Jung, S. Jeong, G. Kim and K. Lee, *Nat. Commun*. **6**, 6503 (2015).
[2] J. Zou, C. Li, C. Chang, H. Yip and A. K. Jen, *Adv, Mater*. **26**, 3618 (2014).
[3] W. J. Dong, G. H. Jung and J. –L. Lee, *Sol. Energ. Mater. Sol. Cells*, **116**, 94 (2013).

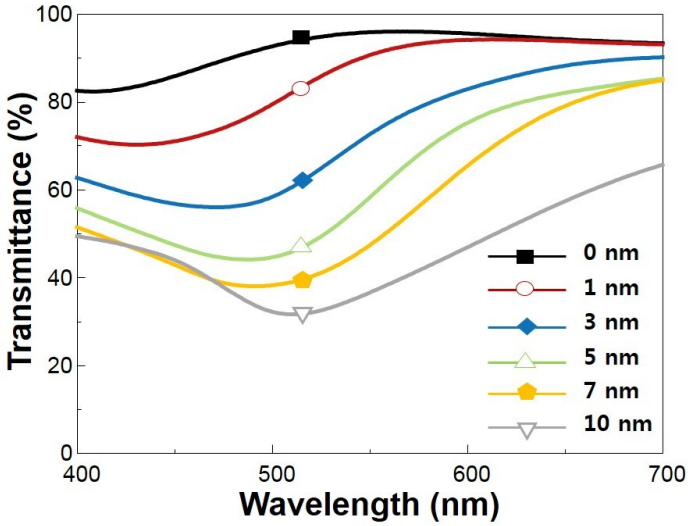

Fig. S6 Transmittance of glass/ITO/Ag nano-dot samples with the increase of Ag nano-dots thickness