OPTICAL PROPERTIES OF THIN METALLIC NANO-PATTERNED FILMS FOR DISPLAY APPLICATIONS

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I. INTRODUCTION

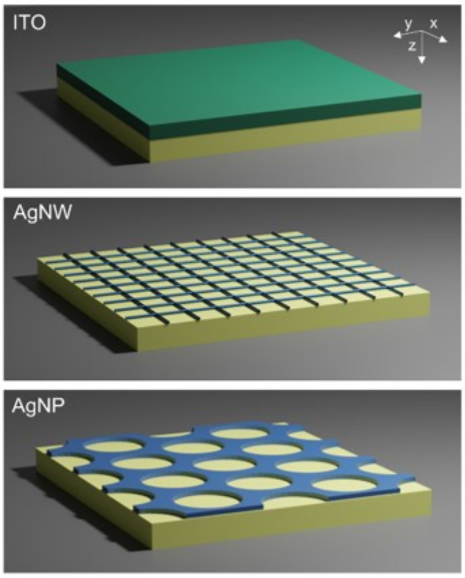
Transparent conductive films are a crucial component of many optoelectronic devices such as displays, solar cells, touch screens, and light-emitting diodes. To date, indium tin oxide (ITO) based TCFs dominate the electronics industry. But a high fabrication cost and non-flexibility of the ITO prevent its application in future generation devices. Among potential candidates such as graphene, polymers and zinc oxide, metallic nanowire and nanoporous layers demonstrate a large potential to replace the ITO [1-4]. Besides low fabrication cost, flexibility and stretchability, they surpass the optoelectronic performance of ITO. Here we demonstrate silver nanowire (AgNW) and nanoporous (AgNP) layers, which possess the transmittance up to 10% higher than ITO at 20Ω/☐ sheet resistance.

II. METHODOLOGY

A commercial-grade simulator based on the finite-difference time-domain (Lumerical Solutions, Inc., https://www.lumerical.com/products/fdtd-solutions) method was used to perform the optical calculations. The incident light in the visible wavelength range from 400 to 700 nm was illuminated along Z axis. The periodic boundary conditions and perfectly matched layers were applied perpendicular to Z and X(Y) axes, respectively. The ITO thickness was set to 100nm. The AgNW diameter and AgNP thickness ware set to 30nm and their surface coverage was set to 90%. For more information about simulation, see our previous work [2-4].

III. RESULTS AND DISCUSSION

Figure 1 shows the simulation model configurations of ITO, AgNW, AgNP and their transmission spectra. We selected the thickness, diameter and surface coverage to obtain 20Ω/☐ sheet resistance for all three layers since this is a common indicator for most display applications. At the same time, the accepted transmittance is about 80% and ITO satisfies such parameter. AgNW outperforms this value and demonstrates the transmittance up to 90%, which is 10% higher than ITO. AgNP has almost the same superiority but in the wavelength range from 500 to 700nm and has slightly higher transmittance (up to 5%) from 400 to 500nm.



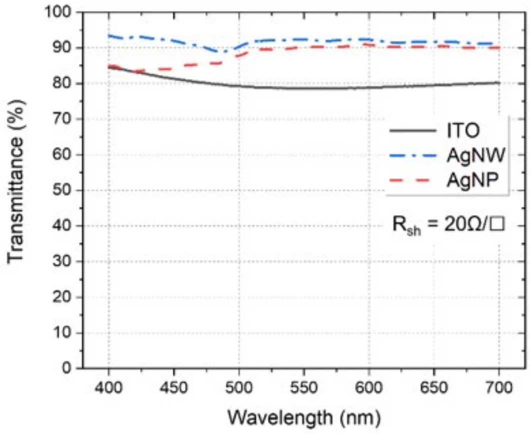


Figure 1. (left) ITO, AgNW and AgNP model configurations and (right) their transmission spectra

IV. CONCLUSIONS

We investigated ITO, AgNW and AgNP as TCFs for display applications. AgNW and AgNP exceed the transmittance by 10% compared to ITO at 20Ω/☐ sheet resistance. Considering this, AgNW and AuNP may become potential candidates to replace the ITO in the near future.

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