

Metal-based transparent conductor: from metal nanograting to ultra-thin Ag film, with applications in optoelectronics

L. Jay Guo

*Department of Electrical Engineering and Computer Science
The University of Michigan, Ann Arbor, MI, 48109*

Metal is the best electrical conductor, but optically opaque. Our journey of developing metal-based transparent conductor started two decades ago, with the original objective to use patterned Ag or Au film with nanohole arrays to function not only as an electrode (replacing ITO) to inject charge carriers, but also to enhance light output by exploiting the extraordinary transmission due to plasmonic resonance. The effort has led to the concept of metal wire-grid structures with tunable optical transparency and electrical conductivity. To scale up the fabrication, we developed roll-to-roll nanoimprinting process that can create nano- and microscale structures continuously. For more practical manufacturing, we turned our attention to ultra-thin silver film by physical vapor deposition, and were able to suppress the typical island formation during Ag deposition by introducing “metal doping”. The result is silver films with drastically improved quality that enables a continuous and smooth film formation down to 5.5 nm. Coupled with optical design we obtained high performance flexible transparent conductor, which has been used in OPVs to enhance its power efficiency, and in OLED to eliminate light trapping, and in realizing transparent electromagnetic shielding. Such thin films can be manufactured by the mature roll-to-roll sputtering, which facilitates industrial applications.

Bio:

L. Jay Guo is the Emmett Leith Collegiate Professor of Electrical and Computer Engineering at the University of Michigan. He currently serves as the director of the Macromolecular Science and Engineering program, and holds courtesy appointment in Mechanical Engineering, and Applied Physics. He is a fellow of IEEE and a fellow of Optica. Professor Guo's lab is involved in interdisciplinary research, with activities ranging from polymer-based photonic devices and sensor applications, flexible transparent conductors, nanophotonics, structural colors and AI assisted design, hybrid photovoltaics and photodetectors, to nanomanufacturing technologies. Professor Guo has 295 journal publications; with citation more than 35,000 times, and an H-index of 92 (by google scholar). His professional service includes co-Editor-in-Chief of *Micro and Nano Manufacturing*, and associate Editor for the IEEE Journal of Photovoltaics. He serves on the Advisory Board of *Advanced Optical Materials* and the Editorial Boards of *Opto-Electronic Science* and *Opto-Electronic Technology*. His entrepreneur activities include co-founding two startup companies to commercialize technologies from his lab.

