Plasmonics and Metamaterial Enhanced Super-Resolution Microscopy

*Zhaowei Liu**

Department of Electrical and Computer Engineering,
University of California, San Diego
La Jolla, California, United States

zhaowei@ucsd.edu

Plasmonics and metamaterial assisted structured illumination microscopy techniques have recently been proven to be a promising approach for linear super-resolution microscopy with exceptionally large resolution improvement factors. Specifically, metamaterial assisted illumination nanoscopy (MAIN) has demonstrated up to a >7-fold improvement in imaging resolution. Further resolution enhancement is possible in principle, however, has not yet been demonstrated due to the lack of high-quality ultrathin layered hyperbolic metamaterials (HMMs) used in the MAIN. In this talk, I will present our most recent result of MAIN by using a low-loss composite HMM consisting of high-quality bilayers of Al-doped Ag and MgO, and a high figure of merit organic hyperbolic material based on P3HT. With these state-of-the-art optical hyperbolic materials, we demonstrated MAIN with >14-fold imaging resolution improvement. This improvement of resolution is achieved in both single fluorescent beads and adjacent fluorescent beads super-resolution experiments and verified with the scanning electron microscopy. Similar super-resolution idea has also been extended to label-free scattering imaging with greatly improved resolution. The MAIN represents a simple super-resolution imaging approach that offers distinct benefits such as low illumination power, high photostability, low cost, and a broad spectrum of selectable probes (or label-free), making it ideal for dynamic imaging of life science samples.

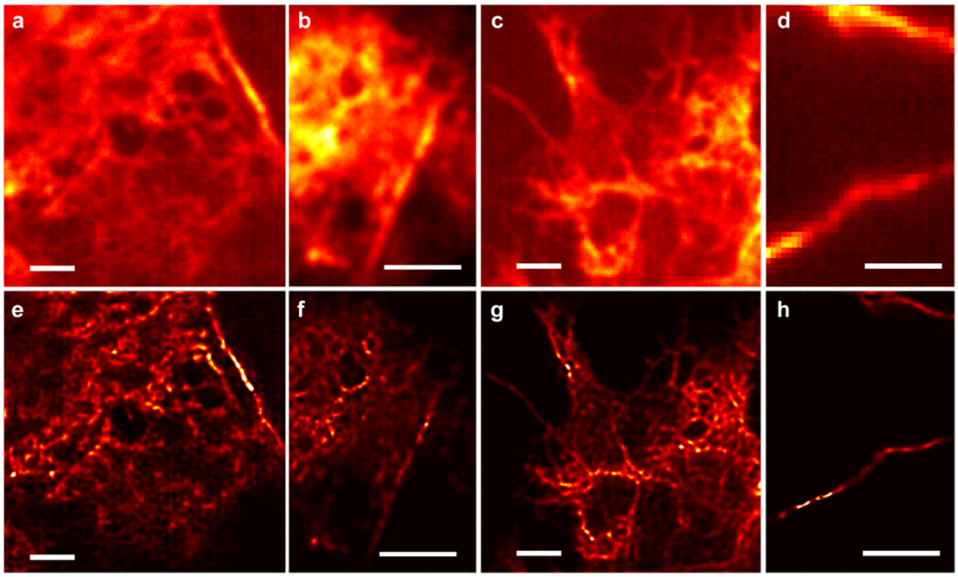

Figure 1. Venus-CAAX tagged Cos-7 Cell membrane images. (a-d) Conventional wide-field image. (e-h) Super resolution images. The scale bar, 2um.

[1] Lee, Y. U. et. al., *Nature Comm.* **2022**, *13*, 6631.
[2] Lee, Y. U. et. al., *Nature Comm.* **2021**, *12*, 1559.
[3] Lee, Y. U. et. al., *Adv. Sci.* **2021**, *8*, 2102230.