

Designing a super-lens suitable for live cell imaging

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The possibility of creating surface-plasmon excitation based super-lenses capable of sub-diffraction imaging of biological systems has been alluded to in the literature for several years now [1]. However, to date the realization of a suitable design is lacking due to the unavailability of materials with optimal properties as well as practical limitations on fabricating the required structures [2].

Here we present calculations and simulations for various composite metal-dielectric super-lenses operating in different host mediums at optical frequencies. We thereby show that a $\text{Ag}_{1-x}\text{Si}_x$ ($x=0.1-0.2$) film immersed in a SiC host medium will super-lens at $E \approx 2.44\text{eV}$ ($\lambda_0 \approx 510\text{nm}$, “green-light”). A full theoretical consideration of the transmission properties of this composite super-lens structure shows that it is capable of separately resolving two GFP molecules, located at distances 30nm from the lens, and separated by 50nm ($\approx \lambda_0/10$). We show that the optical and material parameters of such “easy-to-build” super-lenses are in all other respects conducive to dynamic 2-*d* super-resolution imaging of biological systems.

We will also briefly discuss some of our ongoing efforts to develop a super-lens based microscopy setup, and tailoring it to studying the dynamics of recently observed cell adhesion complex substructures in GFP-labeled fibroblasts [3].

References

- [1] See e.g. N.I. Zheludev; “What diffraction limit?” *Nat. Mat.*, **7**, 420-422 (2008).
- [2] See e.g. A. Boltasseva; V.M. Shalaev, “Fabrication of optical negative-index metamaterials: Recent advances and outlook,” *Metamat.*, **2**, 1-17 (2008).
- [3] E. Shroff; C.G. Galbraith, J.A. Galbraith, and E. Betzig, “Live-cell photoactivated localization microscopy of nanoscale adhesion dynamics,” *Nat. Meth.*, **5**, 417-423 (2008).