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A laser beam without diffraction spreading

Yikuan Wang[1] and **Marc Achermann**[2]
[1]Yancheng Teachers University, China
[2]Lucerne University, Switzerland

Optical diffraction not only sets a resolution limit to optical imaging instruments but also makes sub-wavelength-width laser beams impossible. Remarkable progress to beat diffraction limit has been made, such as STED, STORM, PALM, NSOM, and NIM for perfect images. However, the use of surface plasmon resonances (SPPs) to circumvent diffraction spreading has not come out yet. Here, for the first time, to the best of our knowledge, we show that coupling SPPs to appropriate dielectric material in planar multilayer films can result in a fundamentally down-sized laser beam without diffraction spreading. For example, when 531 nm red light impinges on the planar stacks with an incident angle of 46O, the transmittance of Si_3N_4/Ag(45nm)/water vanishes, while the transmittance of Si_3N_4/Ag(45nm)/water/Si_3N_4 is 0~48.9%, which depends on the gap size of water, demonstrating strong coupling interactions of SPPs and the coating dielectric. If both structures run side by side, the composite structure can turn optical waves partially on at far field distances simultaneously. Both the beam size and intensity of the outgoing light rely on the choice of the coupling dielectric material and the thickness of the dielectric material that hosts SPPs. This modification of wave-fronts of collimated light opens up a new route towards down-sized, especially nano-sized laser beams which holds promise for ultrafast laser nano-imprinting of nanopores for DNA sequencing and other 3D photonic devices in the telecommunications and optical signal processing industries.

Biography

Yikuan Wang studied Physics PhD with hands-on experience in materials preparation, instrumentation, spectroscopy, and computation skills in electromagnetic field simulation.

haw_cn@yahoo.com