Integrated nano-plasmonics: reflecting a waveguide mode with a single nano-antenna

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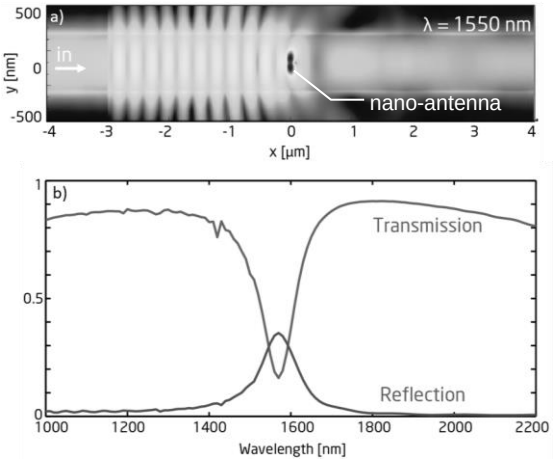
Integrated plasmonic systems have the potential to revolutionise telecom devices [1]. However, the large losses and poor efficiency of plasmonic systems [2] have limited the use of metallic systems as optical circuits. Here we present a hybrid silicon-metallic system in which a single nano-antenna embedded in a single-mode silicon waveguide acts as a tuneable and narrow-band switch. Nano-antennas interact very strongly with light [3], such that when the nano-antenna is at resonance with the waveguide mode up to 80% of the light is blocked by it. This drop in transmission is a consequence of scattering and interference between the dipole and the waveguide mode, which is efficient over the nano-rod resonance bandwidth. The high performance and simplicity of this hybrid device holds great promise for future optoelectronic circuits.



Integrated nano-antenna in a Si waveguide. FDTD calculations of the (a) field distribution along a silicon waveguide with a gold nano-antenna embedded inside it and (b) transmission and reflection versus wavelength for the same system. At telecom wavelengths the transmission drops to near 20% while the reflection at the antenna position reaches almost 40%.

References

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