Optical antennas for optoelectronics: Impacts, promises, and limitations

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The weak nature of photon interaction with the electronic states of materials is the main limitation in many technologies, such as solar energy harvesting, spectroscopy, infrared imaging, remote sensing, and optical tomography. For example, single-photon detectors with unprecedented sensitivity could be achieved, if strong interaction between photons and a low dimensional quantum electronic system is achieved. Similarly, highly efficient solar cells can be realized once this limitation is eliminated. Optical antennas have been a rapidly growing research area that could directly address this issue. Currently, metallic structures are being widely studied for use as optical antennas. Many groups, including ours, have shown remarkable improvements [1], using such structures [2] at infrared wavelengths. We present latest results regarding optical antennas, including new ways they could be used as very efficient optomechanical devices [3]. We will also look into some of the practical limitations of current approaches, and their theoretical limits.

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