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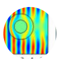

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Ultra-Broadband Matching and Funneling of Light at the Plasmonic Brewster-angle

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Abstract: The concept of plasmonic Brewster angle tunneling is applied to realize ultra-broadband funneling of electromagnetic radiation through plasmonic gratings and more exotic applications, such as omnidirectional absorbers and selective thermal emitters.

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OCIS codes: 160.3918 Metamaterials, 160.4670 Optical Materials, 260.3910 Metal Optics, (120.6810) Thermal effects.

In our talk, we will present our recent theoretical and experimental findings towards ultra-broadband matching and funneling of electromagnetic radiation through one-dimensional (1D) and two-dimensional (2D) metallic gratings. During our previous works [1][2], we introduced the innovative concept of plasmonic Brewster angle tunneling in order to achieve ultra-broadband transmission and concentration of electromagnetic energy through metallic gratings. We demonstrated that periodic grooves or slits curved on a plasmonic grating may be completely matched to free-space or other surrounding material over an ultrabroad range of frequencies, around a specific angle of incidence (the plasmonic Brewster angle) and for transverse-magnetic (TM) polarized incidence waves. This effect is very distinct from conventional extraordinary optical transmission phenomena, which are based on narrowband resonant tunneling mechanisms, such as Fabry-Perot (FP) resonances and surface plasmons excited at the subwavelength grooves or slits of the grating [4],[3].

In the present work, we will use the Transmission-Line (TL) method to further analyze the time and frequency dynamics of the plasmonic Brewster angle effect. It will be proven that we do not need input and output interfaces to establish the tunneling phenomenon, as in conventional FP resonant tunneling, because it is only based on perfect matching of the impinging electromagnetic radiation. Moreover, we will analyze more practical set-ups; for example, the case when the plasmonic grating is built on a dielectric substrate. The grating will be properly patterned, in a similar way to photonic crystal configurations, in order to obtain 2D quasi-isotropic functionality on a plane, which however still remains polarization sensitive. Experimental verification of the concept at microwave frequencies will be presented based on an array of ultranarrow slits in an aluminum screen, which demonstrates that the phenomenon can be obtained to lower frequencies, where the plasmonic nature of metals ceases to exist.

Finally, interesting applications will be proposed based on the plasmonic Brewster angle concept, such as omnidirectional absorbers and selective thermal emitters, envisioned to operate at THz, infrared (IR) and visible frequencies. The plasmonic 1D and 2D gratings will be elongated and adiabatically tapered to achieve perfect ultra-broadband concentration and absorption of the electromagnetic energy, leading to exciting energy harvesting applications. Furthermore, selective thermal emitters will be demonstrated, built by the aforementioned plasmonic grating geometries, which can potentially emit spatially coherent ultra-broadband radiation confined around the plasmonic Brewster angle. Novel thermal radiator devices and light-emitting diodes (LEDs) can be built based on the proposed ideas. All these interesting applications will be presented in detail during the conference.

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