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Abstract

Magneto-Plasmonic Nanostructures and Crystals †

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Abstract: The fundamentals aspects of the key physics underlying the optical behavior of magneto-plasmonic nanoantennas are briefly introduced. A survey of applications to a variety of emerging technologies is presented as an example of their broad scientific and technological perspectives.

1. Introduction

Plasmons play a large role in the optical properties of metals. The rapidly developing field of magneto-plasmonics merges the concepts from plasmonics and magnetism to realize novel and unexpected phenomena and functionalities for the manipulation of light at the nanoscale. Magneto-plasmonics combines strong local enhancements of electromagnetic fields in surface plasmon excitations with magneto-optically active ferromagnetic materials. Owing to the intertwined optical and magneto-optical properties, magneto-plasmonics may offer a smart toolbox for actively magnetically tunable optical ultrathin surfaces and metasurfaces.

2. Content

Here we review fundamentals aspects of the underlying physics [1–3] and recent advances in the research on magneto-plasmonic nanoantennas and two-dimensional magneto-plasmonic crystals [4-16]. From the one side, they contributed to broaden the understanding and control of optics at the nanoscale. From the other side, magneto-plasmonic nanoantennas and surfaces have already shown a clear path towards applications to variety of emerging technologies as, e.g., ultrasensitive molecular sensing and ultrathin optical devices. A survey of applications to a variety of emerging technologies are presented as an example of the broad scientific and technological perspectives of magneto-plasmonic antennas and crystals, namely:

- magneto-plasmonic nanoantennas for ultra-sensitive and label-free molecular detection [4–8];
- ultra-thin 2D chiroptical surfaces, built on magneto-plasmonic bimetallic meta-atoms where chiral light transmission is modulated by the externally applied magnetic field [9];
- 2D magneto-plasmonic crystals, which support collective modes (surface lattice resonances) or surface plasmon polariton modes displaying a two-dimensional photonic band structure that can be engineered to obtain tailored and enhanced magneto-optical response [11–15];
- thermo-plasmonics based on bimetallic magneto-plasmonic nanoantennas, for harvesting electromagnetic radiation energy and convert it into heat, which can be used to finely tune the magnetization reversal in networks of interacting nanomagnets [16].

Challenges and future work will be briefly discussed.

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