Plasmon-Empowered Nanophotonics: from Circuitry to Metasurfaces

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Surface plasmon polaritons, often shortened to surface plasmons (SPs), represent hybrid excitations involving free electron oscillations in metals and electromagnetic fields in dielectrics that propagate along and strongly bound to metal-dielectric interfaces. These surface electromagnetic waves enable deeply subwavelength confinement of guided modes along with strong enhancement of optical fields, two major features of SP modes that have been and continue being advantageously exploited in plasmon-empowered nanophotonics [1]. It would be impossible to overview, even very briefly, all fascinating topics found within plasmonics that include metasurfaces, graphene and other 2D materials, strong-coupling phenomena, topological plasmonics, quantum plasmonics, hot-electron phenomena, and many other topics even when considering only those presented at the last conference on Surface Plasmon Photonics - SPP9 (Fig 1).

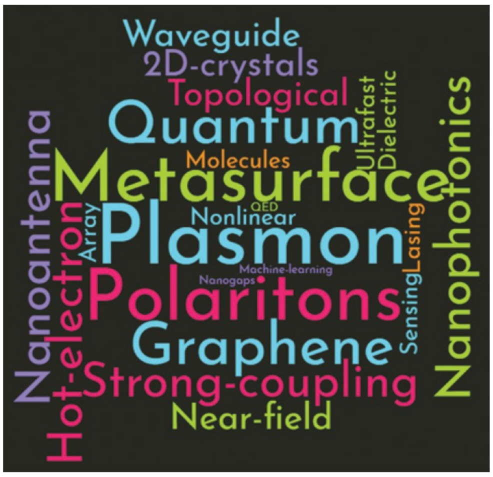

Fig. 1 The breadth of research topics and directions within plasmonics illustrated by a word cloud compiled from the book of abstract from the 9th International Conference on Surface Plasmon Photonics (SPP9) held in 2019 [2].

In this talk, special attention is given to the progress in ultra-compact photonic circuitry, including modulators and detectors, and plasmonic metasurfaces dynamically controlling propagation of light. In particular, the most efficient and ultrafast electro-optical modulators [3] and deflectors [4] utilizing the commercially viable material, LiNbO3, in which the radiation transport is controlled using the same metal circuitry for both guiding SP modes and delivering electrical signals, are presented along with the realization of on-chip electrical detection of guided SP modes [5]. Plasmonic metasurfaces [6], which can be considered as the two-dimensional analogue of metal-based metamaterials, used for room-temperature generation of single-photon streams carrying orbital angular momenta [7] and dynamic control of metasurface-enabled focusing [8, 9] and optical birefringence [10] are also discussed. A personal view on the nearest perspectives for plasmon-empowered nanophotonics concludes this talk.

References

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