# Sub-Wavelength Propagation of Surface Plasmons and SPASERs and Their Applications in Future ICs and Systems

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ABSTRACT

An electromagnetic wave incident on a conductor gives rise to charge density oscillation and creates bulk and surface plasma waves. In a metal-insulator (semiconductor) interface the charge density oscillation may lead to localized or propagating surface plasmons or surface plasmon polaritons (SPPs). The electric field at the interface decays exponentially in both the metal and insulator. The high field at the interface is the origin of strong light-matter interaction. The propagating SPP wavelength is always less than that of the exciting optical wave, thus overcoming the fundamental diffraction limit and leading to sub-wavelength propagation. However, the longitudinal propagation length is quite low, even a few tens of nm.

The subwavelength nature of surface plasmons, apart from the study of novel physical phenomenagiving birth to a new subject named as Surface Plasmonics, is exploited for device applications. In particular, the subwavelength nature of SPPs is exploited to fabricate waveguides, sources, modulators, detectors etc. needed for information processing. As the ultimate size of photonic devices is diffraction limited, plasmonic devices can overcome the large size mismatch between electronic and photonic systems. A new type of emitter based on Surface Plasmon Amplification by Stimulated Emission of Radiation (SPASER) overcomes the decay of SPPs and forms a current hot topic of research and development.

This talk aims at giving an elementary overview of Surface Plasmonics including the basic physics, different characteristics, structures and principle of operation of SPASERs and other plasmonic devices. The expected use of plasmonics in interconnects in next generation data centres and high-performance computers will be pointed out. A brief mention of the work by the author’s team will be made at the end.