Optical Nano-antennae as Compact and Efficient Couplers from Free-space to Waveguide Modes

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Optical nano-antennae are one of the possible solutions for coupling free-space radiation into subwavelength waveguides. Other possibilities include, among others, grating couplers and end-fire end couplers. Our efforts were concentrated on nano-antennae used for coupling IR light in the telecom range from an optical fibre to a plasmonic slot waveguide. This type of coupling is still difficult to achieve and finding an efficient way in obtaining it would advance the use of plasmonic waveguides for optical interconnects.

During the talk, we will present our modelling optimisation, fabrication and measurement of the nano-antennae functionality. For the modelling part, we used CST Microwave studio for optimising the antenna geometry. Based on initial estimates for standard nano-antennae, we developed a strategy for optimising them taking into account both the theoretical description of the metallic layers at these wavelengths and the fabrication possibilities. We then fabricated the obtained geometry. The fabrication was based on electron beam lithography and lift-off processes. But with several optimisations due to the low dimensions involved and the dielectric substrate used. We performed the measurements using scattering near field microscopy and thus we could retrieve both the amplitude and the phase of the propagating plasmon. Advanced post-processing techniques were used in order to filter out the excited plasmons that are propagating perpendicular to the slit.

Using interpolation techniques we extracted the propagation lengths of the slit plasmons as well as determined the coupling efficiency. The obtained values agree very well with the theoretically predicted ones thus validating our approach. All the procedures used in optimising and processing the data will be presented during the talk.