NANOPHOTONICS-DERIVED METHODS OF FABRICATION

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Optical near-field phenomena occur in the fields close to the interfaces of nanoscale-sized particles. Advantages of using the near-field, such as its sub-diffraction-limit imaging capabilities (when used in scanning probe configurations) triggered the rapid growth of near-field optics in the 90s, after its inception in the mid 80s. Despite many exciting developments in the imaging field and even the emergence of entirely new research fields, such as single molecule spectroscopy, recent years have shown that this is only the tip of the iceberg.

Transcending the diffraction limit in fact was not the only, or even main advantage of this technology. Investigations in the area of optical near-field based nanophotonics are revealing that the near-field has the capacity to realize novel functions based on local electromagnetic interactions [1]. Indeed, it enables the fabrication, operation and integration of novel ‘nanometric’ devices. This area of basic research is just beginning to demonstrate its massive potential to solve many current technological problems. Only a few years after the initial attempts at maskless deposition of nanoscale features using optical near-field [2,3], the operation of all-optical switch, de-facto true nanophotonic device, was demonstrated [4]. Even though it was not purpose-fabricated with nanoscale precision but, rather, a pre-existing molecular arrangement was sought in a suitable inorganic matrix, there is a growing number of experimental results indicating that fully fledged fabrication of such nanoscale devices using near-field configurations is feasible.

Compared with other methods in the domain of nanofabrication, nanophotonics-based solutions were somewhat overlooked. This is partly because this field is still technologically immature. It deals with many ill-understood and size-dependent phenomena that would seem to be largely atypical quantum effects; offering non-linear interactions without the usual power requirements. The potential of such low-power non-linearities is enormous, especially if applied to problems that currently stifle progress in micro- and nanofabrication. Moreover, nanophotonics-based disruptive technologies may provide a path to bypass a number of undesirable industrial processes that involve toxic components and equipment with a high cost of ownership. In the context of such problems, we will present our work on applying optical near-field to dry etching experiments.

References:

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