Resonant Dielectric Nanostructures of ZnO for fluorescence enhancement

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The goal of our study is to make novel bio-array substrates which use concentrated optical near-fields with remarkably enhanced field intensity by means of integrated periodic nanostructures. Beside the sensitivity enhancement in comparison to commonly used chips, the new substrate is fabricated by using low-cost materials achieved by innovative nano-structuring procedures.

We report the fabrication of dielectric materials such as ZnO nanopillar arrays and study of their electromagnetic resonance behavior for field-induced fluorescence enhancement and their application in the optical biosensing technology. To study the strong field intensity enhancement, several optical and geometric parameters of ZnO periodic nanopillars were systematically varied and manufactured via innovative lithographic and replication processes. Reproducible high quality nanostructures can also be obtained for different structural parameters (i.e. periods, diameters and heights) on transparent glass slides coated with a thin layer of Indium Tin Oxide (ITO).

The field enhancement generated from the dielectric nanostructures was also theoretically analyzed by fully 3-D calculations, using an in-house developed code (hades3d). All in all, experimental and computational results show strong fluorescence enhancement, which will definitely contribute to develop more efficient and sensitive biosensors.