Silicon nanodisks for Surface Enhance Raman Scattering

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All-dielectric resonant nanophotonics based on dipolar and multipolar Mie-type resonances have recently emerged as a new research field for the design of nanoscale metadevices. [1] New types of Surface Enhance Raman Scattering (SERS) non-plasmonic substrates are of particular interest for the study of light-matter interactions of novel nanomaterials such as transition metal dichalcogenides (TMDs) thanks to their ability to produce localized hot spots with lower absorption and thermal effects than in their plasmonic counterparts. [2-3] Here, we present a theoretical and experimental study of different designs of SERS substrates based on silicon-disk nano resonators. Their efficiency and operation are tested by the integration with TMDs and self-assembled monolayers (SAMs) of molecules chemically compatible with the Silicon nanostructures. First, the Raman scattering signal enhancement is studied by depositing by spin coating, mono and few layers of chemically exfoliated MoS_2 onto two types of dielectric nanopatterned surfaces: 1- Silicon single nanodisks and 2- Silicon dimers with different gaps. We observe Raman enhancement factors comparable to those reported for dry exfoliated monolayer TMDs coupled to dielectric nano-antennas (Figure 1). [4] Further effects are observed in the Raman polarization dependence and in the scattering signal enhancement of the same type of Silicon nanostructures now functionalized with aminopropyltriethoxysilane (APTES) .

REFERENCES

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FIGURES

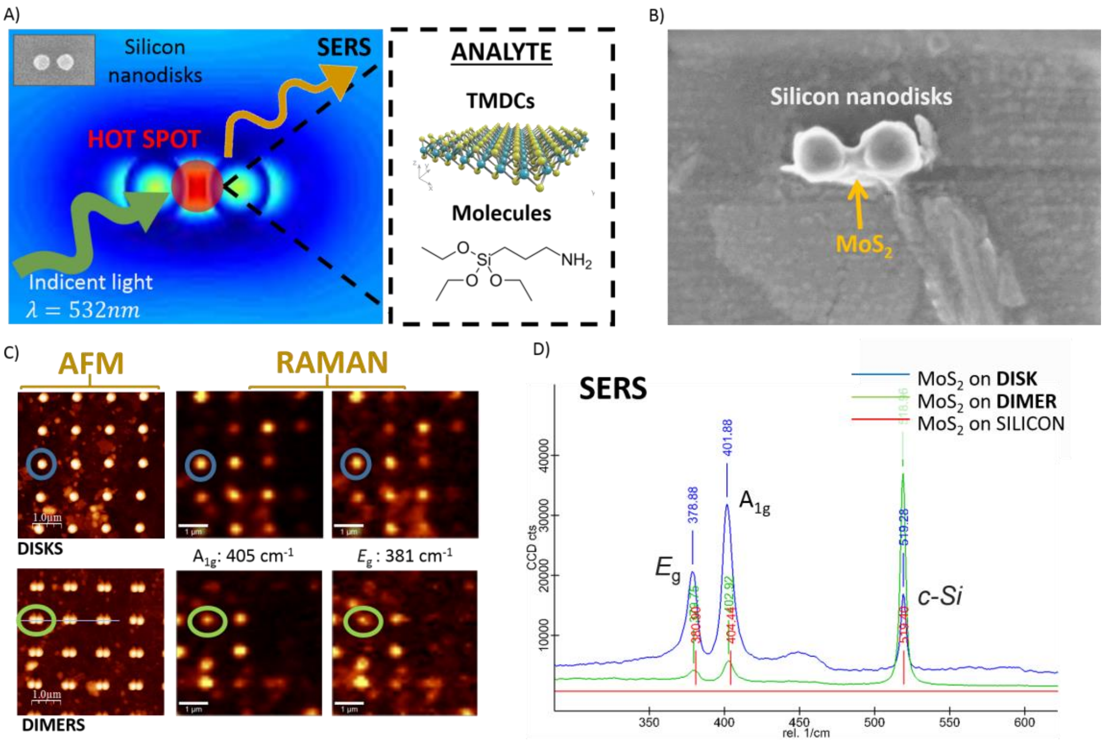

Figure 1: A) Scheme of SERS process superposed on a CST simulation of the Electric field of a Si dimer. B) SEM image of spin-coated MoS_2 onto a Si dimer, C) Same area of AFM and Raman scattering images (5x5 µm^2) of spin-coated MoS_2 onto Si disks (top) and dimers (down), D) Raman scattering spectra of a 4L-MoS_2 flake taken onto a disk and a dimer (marked in blue and green respectively in C)) and onto planar Silicon.