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NANOTECHNOLOGY WITH PRECIOUS METALS: FROM COVID-19 DIAGNOSTIC TO SINGLE-MOLECULE SPECTROSCOPY

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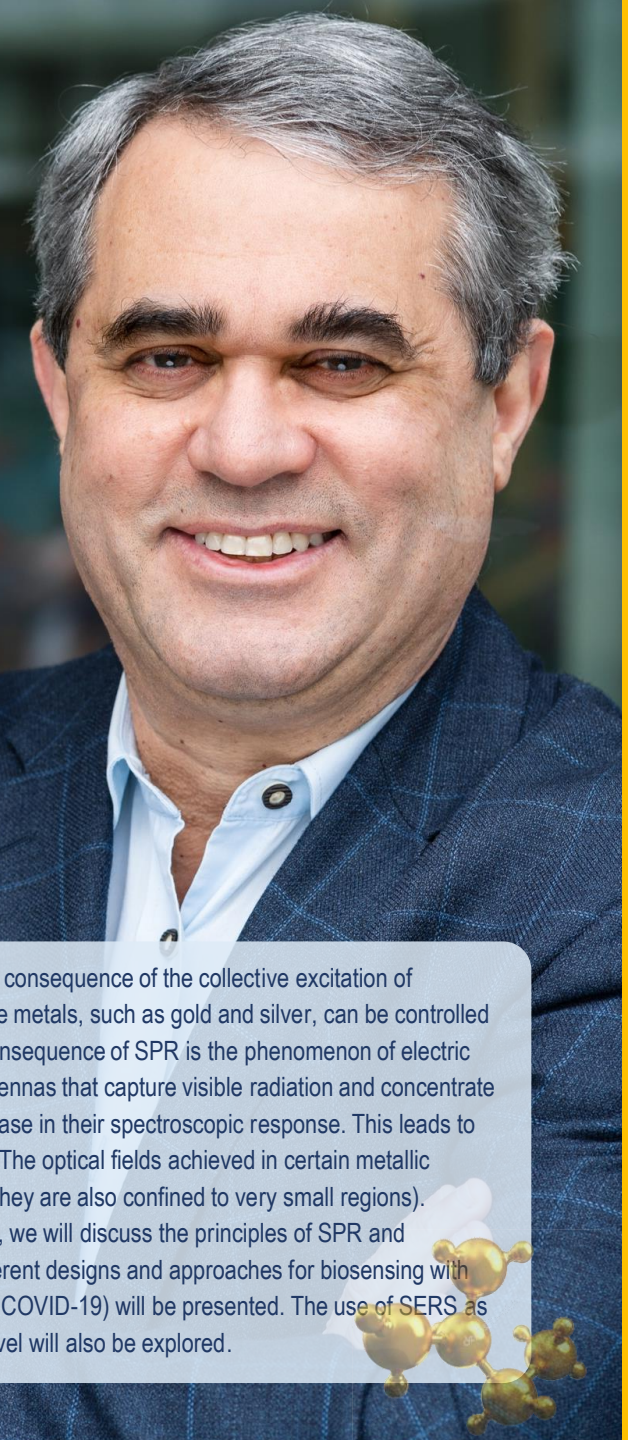

A variety of new properties emerges in nanostructured metallic materials. These new properties are consequence of the collective excitation of conducting electrons, known as surface-plasmon resonances (SPR). For instance, the color of noble metals, such as gold and silver, can be controlled at the nanoscale by tuning the geometric characteristics of the nanostructures. A very interesting consequence of SPR is the phenomenon of electric field localization. Once the SPR condition is established, metallic nanostructures can act as tiny antennas that capture visible radiation and concentrate it in sub-wavelength regions. Molecules exposed to the localized fields can experience a large increase in their spectroscopic response. This leads to unique spectroscopic phenomena, such as the surface-enhanced Raman scattering (SERS) effect. The optical fields achieved in certain metallic nanostructures can be very strong and only accessible to a very small number of molecules (since they are also confined to very small regions). Ultimately, in certain conditions, SERS allows the detection of single adsorbed species. In this work, we will discuss the principles of SPR and demonstrate some examples of applications in biomedicine and single molecule spectroscopy. Different designs and approaches for biosensing with SPR will be emphasized and applications for the detection of infectious diseases (zika, dengue and COVID-19) will be presented. The use of SERS as a powerful tool for the study of dynamical processes of adsorbed species at the single molecule level will also be explored.