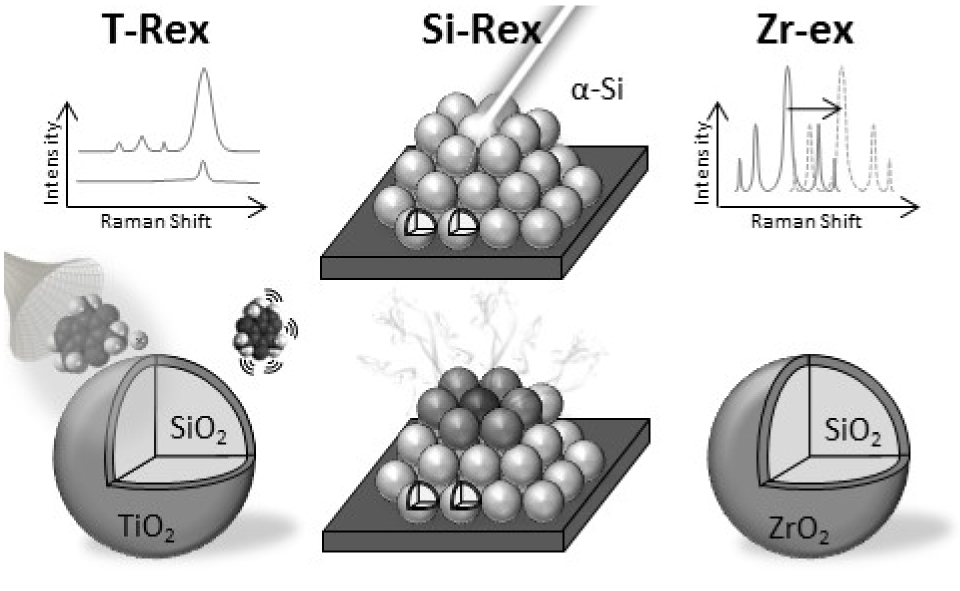
All-Dielectric Core-Shell Resonators for SERS: the family grows and targets multi-modal analysis

Nicolò Bontempi[1], **Ivano Alessandri**[1]

[1]*INSTM and Chemistry for Technologies Laboratory, Mechanical and Industrial Engineering Department, University of Brescia, via Branze 38, 25123 Brescia, Italy. E-mail: n.bontempi002@unibs.it*

All-dielectric antennas and resonators are emerging as new tools for enhancing vibrational spectroscopy [1]. Traditionally, Surface Enhanced Raman Scattering (SERS) exploits plasmonic materials (Au, Ag, Cu) to concentrate the local electromagnetic field. These hotspots may severely alter the information on analytes, for example by causing photothermal degradation or denaturation of specific functional groups. The high refractive index of dielectrics may be exploited to bypass these drawbacks. In addition, they show further important advantages as low invasiveness, reproducibility, versatility and recyclability in comparison to their metallic counterparts.

In the last years we demonstrated that SiO_2 and TiO_2 may be assembled in a core-shell spherical morphology (T-Rex) to generate optical resonators that are able to exploit the evanescent field generated by total internal reflection and multiple scattering of light at the sphere-to-sphere interface. As a result, these materials allow to multiply the number of Raman photons, improving the sensitivity of Raman detection and extending the application of SERS to a reliable investigation of surface chemical reactions [2]. In particular T-Rex beads have been used to detect greenhouse gases [3], biochemical species [4] and biochemical reactions [5]. More recently we have also shown that T-Rex can be exploited for promoting molecular ionisation with UV lasers, which allows to combine SERS with mass spectrometry in a single analytical platform [6].
Here we report the experimental results achieved by extending the palette of high-refractive index core/shell resonators to new shell layers based on amorphous silicon (Si-Rex) and zirconia (Zr-ex). The new materials offer many unique features for multimodal analysis based on the integration of Raman (and infrared) spectroscopy with optical sensing and mass analysis.



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