The potential of Raman spectroscopy as a powerful characterization tool: from materials science to Biointerfaces

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Raman spectroscopy relies on the inelastic light scattering, which provides a highly specific information about the analyzed sample through its vibrational fingerprint. The possibility to get insight into the chemical composition, structure and defect nature of hard and soft matter has allowed its widespread application in several fields of materials science, also in combination with imaging systems. Here the potential of the application of Raman microscopy/spectroscopy to the characterization of nanostructured systems is highlighted through three representative examples. First, the exploitation of Raman scattering for the in-situ study of catalytic processes involving doped ceria nanoparticles and the correlation of their defectiveness evidenced by Raman analysis with the catalytic activity are discussed. Then, Raman imaging of graphene nanoplatelets (GNP) aimed to analyze their edge-functionalization is presented, allowing the identification of localized chemical modifications. Finally, Surface Enhanced Raman Spectroscopy (SERS), which exploits the huge enhancement of the Raman signal from molecules adsorbed on noble metal nanoparticles yielding impressive sensitivities, is applied to the detection of biomolecules through specific assays. In particular, silver decorated dielectric nanostructures are employed for the identification and quantitation of microRNA cancer biomarkers.