UV-SERS ON Cu, Co, AND Pd NANOSTRUCTURES FOR SELECTIVE DETECTION OF SMALL AROMATIC BIOMOLECULES

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Surface-enhanced Raman spectroscopy (SERS) provides chemically specific molecular fingerprint information with sensitivity reaching the single-molecule level. Most SERS studies employ visible or near-infrared excitation; however, in these spectral regions fluorescence background and overlapping vibrational bands can reduce spectral contrast and limit discrimination between closely related biomolecules. In biomedical applications, these limitations are further compounded by substrate heterogeneity and the presence of complex biological matrices. Ultraviolet SERS (UV-SERS) addresses these constraints by exploiting the strong electronic absorption of aromatic biomolecules in the ultraviolet region, which selectively amplifies Raman scattering and improves molecular selectivity (Fig. 1). Many biologically and analytically relevant low-molecular-mass aromatics (nucleobases, aromatic amino acids, flavins, and numerous dyes) have strong electronic transitions in the UV. Thus, excitation at 229–325 nm can place these analytes under resonance or pre-resonance Raman conditions, producing strong, mode-selective amplification of vibrational bands that is not obtained for non-UV-active species. This is explicitly evidenced in your multiwavelength copper study, where π-conjugated analytes (adenine, guanine, riboflavin, 4-mercaptobenzoic acid) show pronounced UV and deep-UV enhancement, whereas an analyte lacking an extended π system (1-dodecanthiol) shows no vibrational signature bands, supporting the selectivity argument [1].

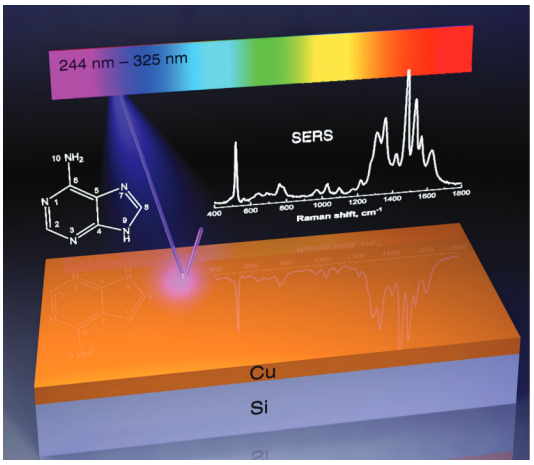

Fig. 1. A schematic representation of UV-SERS of copper-adsorbed adenine

UV-SERS was investigated on transition-metal (Cu, Co, and Pd) nanostructures with emphasis on experimentally validated enhancement mechanisms and substrate reproducibility. Femtosecond laser nanostructuring of 100 nm copper films produced morphology-dependent UV-SERS activity, with maximal adenine enhancement at 325 nm excitation observed for intermediate roughness surfaces exhibiting ring-like nanostructures [2]. Across all systems, reproducible UV-SERS signals were obtained with detection limits down to 10 μM for adenine and stability exceeding two months under ambient conditions. These findings establish copper, cobalt, and palladium-group nanostructures as chemically active, cost-effective UV-SERS substrates.

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