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Al foil and silicon vs Gold Film: when more affordable SERS substrates may compete with gold film substrates

SERS (Surface Enhanced Raman Spectroscopy/Scattering) is a sensitive vibrational spectroscopic technique increasingly tested in bioanalytical and biomedical applications. SERS has significant advantages over fluorescence, such as relatively narrow peaks that may be used for multiplex detection, resistance to photobleaching and no need to modify the analyte molecule with fluorophore (label free nature). In spite several 10000s of publications about SERS in the last 40 years, there is still relatively limited number of clinical/analytical application of this method in everyday life. Among challenges to its applications are relatively high cost and low shelf life/stability of substrates, sometimes insufficient reproducibility of performance, including one due to substrate contamination. The sandwich SERS immunoassays have used gold film as a default substrate by at least several research groups. Our research group tested silicon and then Aluminum foil as the substrate for this sensitive bioanalytical method. Silicon and aluminum foil are not only far more economical substrates than gold, but also substrates that has demonstrated at least comparable LOD and better selectivity / lower non-specific signal in detection of human IgG on Al foil and on Si wafers in comparison to the same performance parameters in simultaneous assays on gold film. The improvement in sensitivity is likely to come from a decrease in nonspecific protein binding to the surface of aluminum and silicon relative to this kind of binding to the gold film surface. We also studied the impact of nanoparticle dimerization on SERS enhancement on various substrates including gold, silver, Al and silicon, using a novel method of AFM/SEM and Raman map combination, published in Nanoscale Advances.

References

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Figures

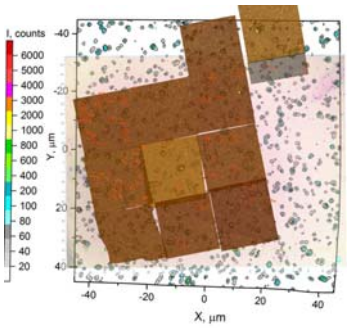

Figure 1: Combination of AFM and Raman + confocal Microscope maps for gold nanoparticles modified with C12 mercaptocarboxylic acid and Raman marker (2-Methoxythiophenol)