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Unmasking Cellular Secrets: SERS-Enhanced Immunological Biomarkers Studies

In recent years, the expression and progression of programmed cell death ligand 1 (PD-L1) as an immunomarker in the context of cell metabolic environment has gained significant attention in cancer research. However, intercellular bioprocesses which control the dynamics of PD-L1 immunomarker has been largely unexplored. This study aims to explore the cell metabolic states and conditions which govern dynamic variations of PD-L1 expression and progression within the cell metabolic environment using Surface-Enhanced Raman Scattering (SERS). The SERS technique offers a sensitive, rapid, and powerful analytical tool that allows for targeted and non-destructive detection of immunomarker with high-sensitivity and specificity. By combining SERS with cell metabolic state-profiling, we investigated the modulation in PD-L1 expression under different metabolic states including glucose deprivation, metabolic co-enzyme activity, and altered time/concentration-based cytokines availability. The most intriguing features in our findings across different cells include the cell-specific responses, cell differentiation by revealing distinct patterns and dynamics of PD-L1 in HeLa, H1299, and A549 cell lines. Additionally, the time-dependent variations in PD-L1 expression, coupled with the dose-dependent relationship between glucose concentration and PD-L1 levels, underscore the complex interplay between immune checkpoint regulation and cellular metabolism. Finally, the measurement of rapamycin levels as an indicator of mTOR activity adds mechanistic insights, emphasizing the potential for tailored immunotherapeutic strategies based on cell type and treatment timing in cancer immunotherapy.

References

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Figures

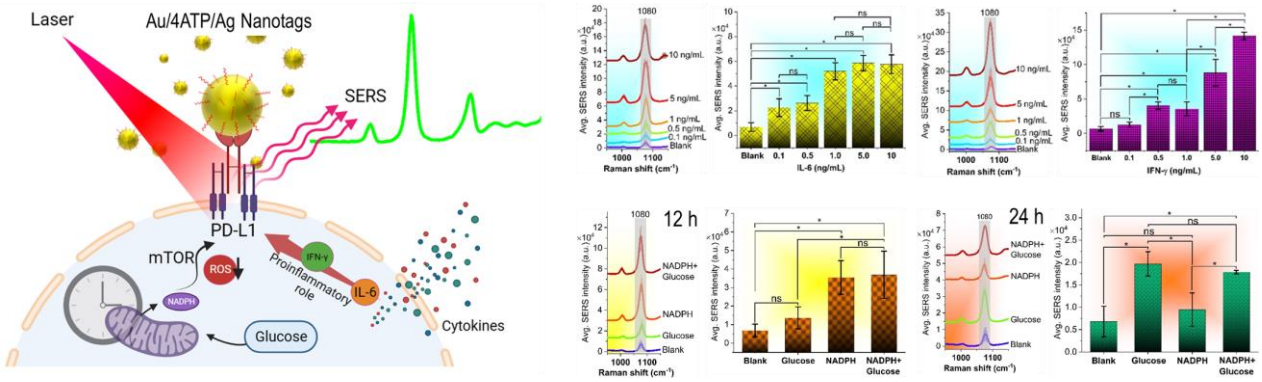

Figure 1: (Left) Schematic representation of SERS nanotags for studying intercellular processes regulating PD-L1 dynamics. (Right) Cytokines, and glucose-NADPH regulated PD-L1 expression detected through SERS.