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MXene-mediated immune cell-cell interactions revealed by enzymatic LIPSTIC labeling

Among two-dimensional nanomaterials, the transition metal carbides/carbonitrides (MXenes) [1] have gained remarkable attention for their potential as biomedical nanotools [2, 3]. Due to their unique physicochemical properties, MXenes enable a wide range of biomedical applications. The use of MXenes was recently explored to fight against SARS-CoV-2, demonstrating the immune-modulatory properties of Ti_3C_2 MXene [4, 5]. The comprehension of the biomolecular effects of MXenes on immune cells is a prerequisite for their exploitation in future translational applications. To characterize the complex interactions between MXenes and immune cells, we applied the Labelling Immune Partnerships by SorTagging Intercellular Contacts (LIPSTIC) [6] approach to nanomaterials (LIPSTIC). A key phenomenon in the immune response, the intercellular communication between T cells and antigen-presenting dendritic cells (DCs), was investigated after exposure to two highly stable and well-characterized MXenes: V_4C_3 and Ti_3C_2. Cell-specific intercellular communication between DCs and T cells was drastically decreased by the former, which induced immunosuppression. Moreover, the anti-inflammatory activity of V_4C_3 was revealed by functional analyses and cytokine quantification. Our results open the way for i) new investigations on the promising immunomodulatory properties of novel MXenes in the context of autoimmune diseases and ii) a novel methodological approach in nanotoxicology and nanomedicine.

References

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Figures

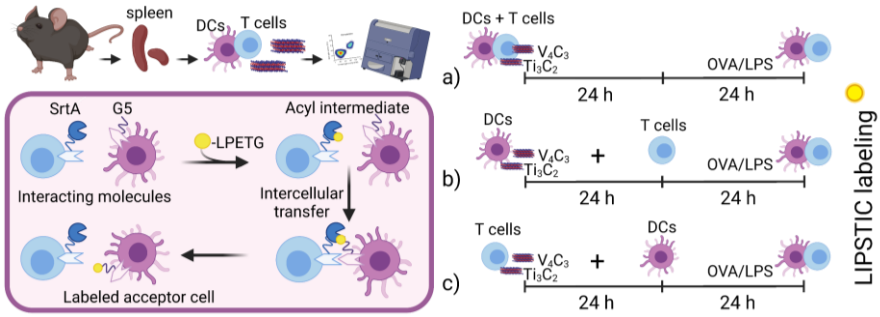

Figure 1: Ex vivo tracking of ligand-receptor interactions using LIPSTIC. Schematic representation of the LIPSTIC approach. Ligand and receptor of interest are genetically fused to either Sortase A (SrtA) or a tag consisting of five N-terminal glycine residues (G5). The loading of a biotinylated LPETG peptide onto SrtA substrate leads to the formation of an acyl intermediate. When ligand and receptor interact, SrtA catalyzes the substrate transfer onto the G5-tagged receptor. After cells separate, the interaction is revealed by the biotinylated label on the surface of the G5-expressing cell (left panel). The LIPSTIC labeling of T cell - DCs interactions was performed as described in the right panel.