

## MXenes against SARS-CoV-2

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### Abstract

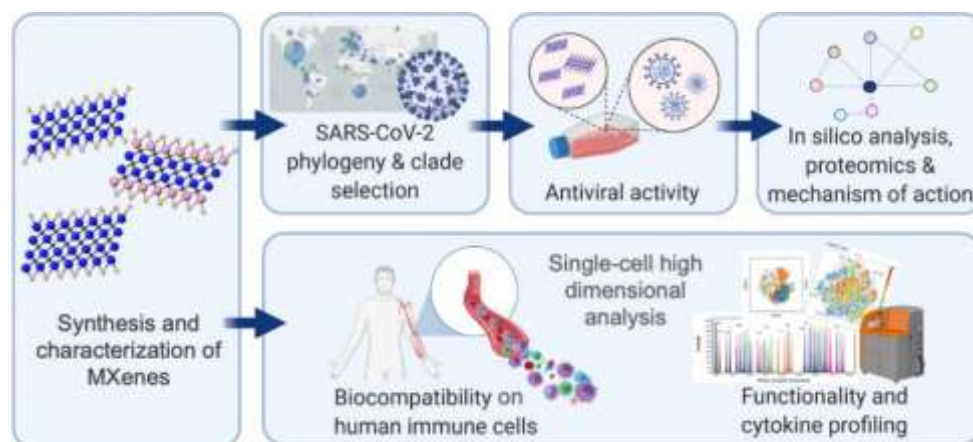
Two-dimensional transition metal carbides/carbonitrides (MXenes)[1,2] are rapidly growing as multimodal nanoplatforms in biomedicine, including against infectious diseases [3]. Here, taking SARS-CoV-2 as a model, we explored the antiviral and immunomodulatory properties of four MXenes -  $Ti_3C_2T_x$ ,  $Ta_4C_3T_x$ ,  $Mo_2Ti_2C_3T_x$  and  $Nb_4C_3T_x$ . We first selected and deeply analyzed four different SARS-CoV-2 genotypes, common in most countries and carrying the wild type or mutated spike protein. When inhibition of the viral infection was tested *in vitro* with four viral clades,  $Ti_3C_2T_x$  in particular, was able to significantly reduce infection only in SARS-CoV-2/clade GR infected Vero E6 cells. Among the other MXenes tested,  $Mo_2Ti_2C_3T_x$  also showed antiviral properties. Moreover, proteomic, functional annotation analysis, and comparison to the already published SARS-CoV-2 protein interaction map revealed that MXene-treatment exerts specific inhibitory mechanisms. Envisaging future antiviral MXene-based drug nanoformulations and considering the central importance of the

immune response to viral infections, the immune impact of MXenes was evaluated on human primary immune cells by flow cytometry and single-cell mass cytometry on 17 distinct immune cell subpopulations. Moreover, 40 secreted cytokines were analyzed by Luminex technology. MXene immune profiling revealed i) the excellent bio and immune compatibility of the material, as well as the ability of MXene ii) to inhibit monocytes and iii) to reduce the release of pro-inflammatory cytokines, suggesting an anti-inflammatory effect elicited by MXene. Taken together, our results provide a compendium of knowledge for new developments of MXene-based multi-functioning nanosystems as antivirals and immune modulators.

## References

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## Figures



**Figure 1:** Overview of the study.