
MXene chemistries and the immune system

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Abstract

Thanks to their unique physicochemical properties, two-dimensional (2D) nanomaterials have attracted increasing attention for their potential to modulate and interact with the immune system, which plays a crucial role in maintaining health, preventing disease, and determining the body's response to biomaterials. We depicted the "Nanommunity-by-Design" concept, where the characterization of two-dimensional (2D) materials is not solely based on their physical-chemical parameters but also on their immune profiling. [1] The immune profiling can only be revealed in its complexity by applying unique and informative high-dimensional approaches. [2,3] Therefore, we exploited high-dimensional approaches, such as single-cell mass cytometry (CyTOF) and imaging mass cytometry on graphene and other novel 2D materials, such as transition metal carbides/carbonitrides (MXenes). [4-6] We revealed that the amino- functionalization of graphene oxide increased its immunocompatibility. [4] Moreover, we combined graphene with AgInS₂ nanocrystals, enabling its detection by CyTOF on a large variety of primary immune cells. [5] We reported the immune modulation of specific MXenes, and their label-free detection by CyTOF and high- dimensional imaging approaches by our LINKED approach. [6,7]. We translated our LINKED approach in the context of environmental nanopollutants, nanoplastics [8]. Together with our more recently published works, [9,10] additional studies will be presented on a wider variety of novel 2D materials, including MXenes, transition metal dichalcogenides (MoS₂ and WS₂), and bismuthene. Our results conceptualize that the chemical and immunological design of 2D materials offers new strategies for their safe exploitation in biomedicine.

References

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