

2D Materials and The Immune System: a Romance of Many Dimensions

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Abstract

The innate or nonspecific immune system has evolved to protect us from harm. Macrophages, along with dendritic cells, act as sentinels, continuously monitoring tissues for the presence of microorganisms. Neutrophils, the most abundant immune-competent cells in peripheral blood, belong to the front-line defence and these cells are key players in inflammation. The immune system is also capable of recognizing non-microbial agents including particles and fibers but do immune cells respond to 2D materials and, if so, how? The growing market for engineered nanomaterials including graphene-based materials raises concerns with respect to their potential impact on human health and the environment [1]. Here, studies conducted in the Graphene Flagship [2] are discussed with emphasis on graphene oxide (GO) and its interactions with macrophages and neutrophils. Continuing our journey into Flatland, we will discuss recent studies of other post-graphene materials, including transition metal dichalcogenides (MoS_2 and WS_2) and 2D metal carbides and nitrides, collectively known as MXenes, with emphasis on their interactions with immune cells.

References

- [1] Keller AA, et al. Developing trends in nanomaterials and their environmental implications. *Nat Nanotechnol.* 2023;18(8):834-7.
- [2] Fadeel B, et al. Safety assessment of graphene-based materials. *Small.* 2025;21(7):e2404570.