Biodegradability of Graphene Family Materials by Immune Response

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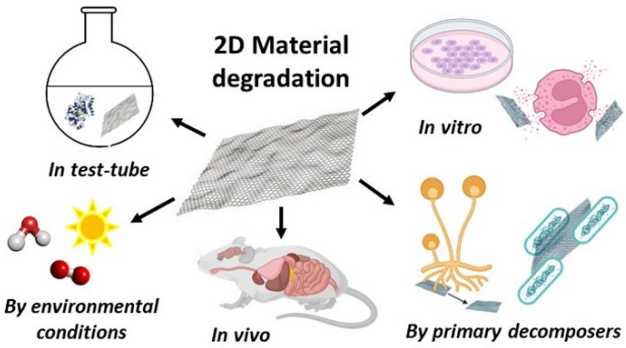
Though graphene family materials (GFMs), including graphene and reduced graphene oxide (rGO), graphene oxide, carbon nanotubes (CNTs), and carbon nano-onions (CNOs), continuously expand their range of industrial and biomedical applications, understanding their long-term persistency due to the inflammatory response in the organisms is still in its infancy. However, the biodegradability of GFMs in organisms by immune cells has shown to be significant, especially by the peroxidase enzymes present in the neutrophils and macrophages. In addition, it is also necessary to thoroughly investigate their metabolite formation by the degradation of GFMs. Herein, we explored the biodegradability of GFMs such as rGO, GO, and CNOs, including graphitic carbon nitride (g-C3N4), by treating them with human myeloperoxidase (hMPO) isolated from the neutrophils plant peroxidase (HRP) and the photoFenton (PF) reaction mimicking the physiological environment during the tumour progression. In addition, we investigated the impact of chemical functionalization on the biodegradability of GFMs and the impact of nanoparticle doping, such as iron oxide nanoparticles (IONPs), ZnS nanoparticles, etc. High-resolution electron microscopy (HRTEM), Raman spectroscopy, Xray photoelectron spectroscopy (XPS), and mass spectrometry (MS) were employed to understand the biodegradation of GFMs and their by-products.1-6 However, these results indicate that the oxidized (functionalized) CNMs can undergo faster biodegradation than the pristine ones. The possible by-products of biodegradation of CNMs were characterized using mass spectrometry. Understanding the biodegradation properties of CNMs and metabolites is fundamental for future biomedical applications.



Ref:
1.R. Kurapati et al. ***ChemNanoMat*,** 2024, 10, e202300630 (Cover page).
2. R. Kurapati et al, ***Carbon*** 2024, 289.
3. R. Kurapati et al. ***Nanotheranostics****, 2024, 8, 150-162.*
4. R. Kurapati (equal contributing) et al. ***Nature Review Chemistry***, 2024 (in press)
5. R. Kurapati *et al.* ***Angew. Chem. Int. Ed.***, 2018, 57, 11722-11727.
6.R. Kurapati et al. ***Angew. Chem. Int. Ed.***, 2016, 55, 5506-5511.