

Needs and challenges in nanomaterials characterisation by XPS and ToF-SIMS

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Abstract

Nanomaterials are considered one of the most important advanced of the last years in the field of materials science. For instance, gold nanoparticles have been deeply investigated due to their peculiar properties making them attractive as (bio)sensors.¹ Moreover, carbon-based nanomaterials, such as graphene and fullerenes, together with other organic and inorganic nanoparticles (e.g. liposomes, polymeric nanodroplets, metal oxides and quantum dots) are strongly investigated because of their potential applications in different fields.²

Despite the great progresses achieved in the last years, several issues are still to be solved encompassing design, stability, potential toxicity and environmental effects of nanomaterials.³ Moreover, a robust and detailed physico-chemical characterisation of the surface functionalization processes is still lacking in many studies and a systematic and reproducible usage of the surface analysis techniques is not yet considered as a common “to do” step in the nanomaterials community.⁴

In this work, I present and discuss some examples on the application of X-ray Photoemission Spectroscopy (XPS) and Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) in the characterisation of nanomaterials with particular attention to the needs and challenges when dealing with nanoparticles samples.

¹ X. Hu, et al., *Front. Bioeng. Biotechnol.* 2020, 8:990, 0c05589; Y. Geng et al., *ACS Nano*, 2020, 14, 15276.

² J. Jeevanandam et al., *Beilstein J. Nanotechnol.*, 2018, 9, 1050–1074; G. Martínez et al., *Materials* 2021, 14, 166.

³ Manning et al, *Biointerphases*, 2018, 1(6); J. Zhao et al., *Critical Rev. Environ. Sci. & Technol.*, 2021, 51(14), 1443.

⁴ M. Mahmoudi, *Nat Commun.* 2020, 12, 5246; D. R. Baer, *J. Vac. Sci. Technol.*, 2020, A 38, 031201; Huei-Huei Chang, et al., *MRS Bull.*, 2020, 45, 392