Reliable chemical characterization of industrial graphene related materials

Jörg Radnik[1]
Giovanni Chemello[1], Vasile-Dan Hodoroaba[1], Tom Howe[2], Neil Vyas[2], Benjamen P. Reed[3], Andrew J. Pollard[3], Charles A. Clifford[3]
[1] *Bundesanstalt für Materialforschung und -prüfung, Unter den Eichen 44-46, 12203 Berlin, Germany*
[2]*Haydale Ltd. Clos Fferws, Parc Hendre, Capel Hendre, Ammanford, SA18 3BL, United Kingdom*
[3] *National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, United Kingdom*
Joerg.Radnik@bam.de

International standards describing reliable protocols will facilitate the commercialization of graphene and related 2D materials [1]. One physico-chemical key property next to flake size and thickness is the chemical composition of the material. Therefore, an ISO standard is under development with X-ray photoelectron spectroscopy having a prominent role [2]. With its information depth of around 10 nm which is the similar length scale as the thickness as of particles of 2D materials consisting of a few monolayer XPS seems to be highly suitable for this purpose. Different sample preparation methods like pressing the powders onto adhesive tapes, into recesses, or into solid pellets result in inconsistencies in the quantification. For the validation of the quantification with XPS an interlaboratory comparison was initiated under the auspice of the "Versailles Project on Advanced Materials and Standards" (VAMAS). First results confirm that the sample preparation method (pellet vs. powder) influences the quantification results clearly. Considering this effect, a good agreement of the results from the different participants were observed (see Figure 1). Similar results were observed for raw, N- and F-functionalized graphene.

References

[1] C.A. Clifford, E.H. Martins Ferreira, T. Fujimoto, et al., Nat. Rev. Phys., 3 (2021) 233.
[2] https://www.iso.org/standard/83450.html?browse=tc, [accessed 2023-04-17].

Figure

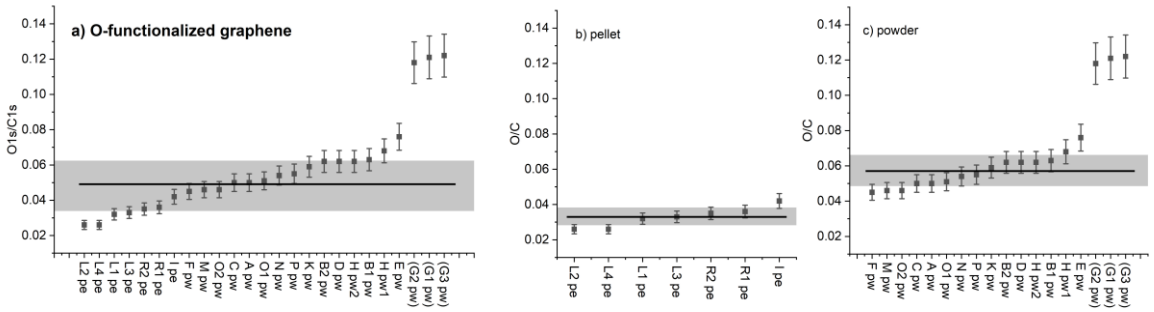

Figure 1: O/C ratios found with XPS from different laboratories for O-functionalized graphene.