Validating the chemical analysis of nanocarbons with certified reference materials

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Abstract
The production of Nanocarbons such as graphene and carbon nanotubes often requires the use of transition metals, thus it is often the case that non-C impurities are introduced in sample batches. To promote the introduction of these materials in consumer goods and technological applications it is essential that reliable information is provided regarding the quantification of these non-intentional elements. It is therefore critical to develop Metrology and Standardization methods and materials for Nanocarbons. Certified Reference Materials (CRM) for Nanocarbons were recently announced by two institutions, the National Institute of Standards and Technology (NIST) US [1] and the National Research Council (NRC) of Canada [2].
Up until now, the complexity of batch-scale elemental quantification for nanocarbons has resulted in neutron activation analysis (NAA) becoming the "gold standard" of analytical methods to address this issue. NAA is non-destructive, accurate and, most importantly, does not require the use of standards. Whilst superior, NAA is not a routine technique for elemental quantification as it requires a large infrastructure with an integrated neutron source. Alternatively, analytical chemistry laboratories often resort to other techniques such as those based in inductively coupled plasmas (ICP). Whether hyphenated to optical emission (OES) or mass (MS) spectrometers, the ICP methods are the "de facto" staple in bulk quantitative elemental analysis of nanocarbons worldwide. Still, one major roadblock persists - the sample preparation step.
During this communication, I will describe some of the recent steps that our group in KAUST has undertaken to resolve this matter. In this, we have made use of the two CRMs available which assisted in validating the approach used for the digestion of nanocarbon samples such as single-walled carbon nanotubes [3, 4].

References
[1] SRM-2483, Certificate of analysis, National Institute of Standards and Technology, United States of America (November 2011).
[2] SWCNT-1, Certificate of Analysis, National Research Council, Canada (June 2013).
[3] SP Patole, F Simoes, TF Yapici, BH Warsama, DH Anjum, PMFJ Costa, Talanta, 148 (2016) 94.
[4] FRF Simoes, N Batra, BH Warsama, C Canlas, SP Patole, TF Yapici, PMFJ Costa, Analytical Chemistry (2016), doi: 10.1021/acs.analchem.6b03407.