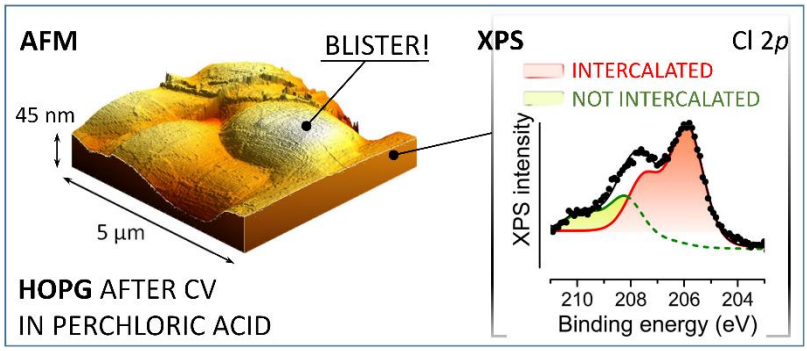
X-ray photoemission spectroscopy as a key technique to highlight intercalation processes in graphite electrodes

Alberto Calloni,[1] Madan S. Jagadeesh,[1] Rossella Yivlialin,[1] Dario Alliata,[2] Lamberto Duò,[1] Franco Ciccacci,[1] Gianlorenzo Bussetti.[1]

[1]Department of Physics, Politecnico di Milano, piazza Leonardo da Vinci 32, 20133 Milano, Italy.

[2]UnitySC, Rue Aristide Berges 611, 38330 Montbonnot-Saint Martin, France



Two representative applications of graphitic materials are, for instance, their implementation as electrodes in batteries or the electrochemical (EC) production of graphene foils. These applications rely on the physical processes of EC-driven graphite oxidation and ion intercalation, actively investigated in view of optimizing both battery duration and quality-rate ratio in graphene production [1]. In this context, highly oriented pyrolytic graphite (HOPG), with its well-defined layered structure, is generally considered a model system to elucidate the modifications occurring within oxidative EC potential ranges.

We have demonstrated that anion intercalation in HOPG can be detected not only at high EC potentials, *i.e.* at or above literature-reported thresholds (the so called "intercalation stages"), but also at lower potentials and allowing for a faster dynamics [2]. Here, we compare the results obtained by using different EC techniques (cyclic voltammetry and normal pulse voltammetry) with two different aqueous electrolytes (*i.e.* perchloric and sulfuric acid). Samples were analyzed in-situ by atomic force microscopy (EC-AFM) and ex-situ by X-ray photoemission spectroscopy (XPS) [3]. Our XPS analysis, being highly sensitive to the chemical condition of the surface and in particular to the presence of intercalated anions, complements the results obtained from the morphological study. Indeed, we found that, notwithstanding the wide range of different surface morphologies realized by tuning the EC parameters, all treated surfaces share the same surface chemical composition and thus the same degree of intercalation, as clearly shown by XPS.

References:

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