

Pacilé *et al.* Reply: In our Letter [1], we reported C K -edge near-edge x-ray absorption fine-structure spectroscopy (NEXAFS) data on single- and few-layer graphene (FLG) measured in ultrahigh vacuum (UHV) conditions by a photoemission electron microscope. Interestingly, both graphene and FLG exhibit at 288 eV a spectral feature located between the dominant π^* and the first σ^* resonance. Based on previous NEXAFS data on highly ordered pyrolytic graphite (HOPG) [2] and on recent experiments and theoretical calculations [3], we assigned this feature to an analogue of the *interlayer state* of graphite.

In their Comment, Jeong *et al.* [4] question this interpretation. They compare NEXAFS measurements performed on pristine HOPG and PG with those obtained after 48 and 96 hours of an oxidation process by acidic attack, where a sharp peak at about 288 eV (called peak “C”) overhangs the π^* resonance. The coincidence in the energy position of the peak C, due to oxidized graphite, with the one we have ascribed to the interlayer state provides a strong argument to the authors to conclude that COOH groups mainly, but CH species also, originate the peak at about 288 eV in our spectra. Remarkably, their x-ray photoelectron spectroscopy (XPS) measurements on pristine PG [5] do not show any chemical shift of C1s, demonstrating that possible residual contaminants seen by infrared spectroscopy on PG must be below the sensitivity to adsorbates of XPS, as well as of any other technique detecting electron emission from the surface.

The heart of the issue is the degree of cleanness of single and FLG samples and their reactivity under irradiation in UHV conditions. The intrinsic inertness of graphene against air exposures has been widely reported in the literature [6]. Functional groups such as COOH or CH_n might be attached at edges. In this respect, it must be emphasized that not a single edge of the graphene sheet is present within the microscopically studied area, but the entire signal was collected from a central region of the flake. The surfaces of mechanically exfoliated graphene remain exceptionally clean even in the presence of ionizing irradiation [7]. The density of adatoms (including hydrogen) and other defects found in Ref. [7], using the same source graphite material as in this study, was found to be below 0.3% (compared to the number of lattice carbons) and thus is well below the detection sensitivity of ca. 5% of a monolayer in our measurements. Further, no evidence of COOH species was found.

During our experiments, we have also performed tests to check the cleanness and reactivity of the graphene flakes. Namely, we observed no notable differences in the NEXAFS spectra of samples annealed up to 800 K in UHV conditions (data not shown) and as a function of time, under continuous beam irradiation [Fig. 1(a)]. Figure 1(b) shows the full C(K)-edge photoabsorption spectra of graphene and FLG (see also Fig. 4 of Ref. [1]) as extracted from sample S2 (see Fig. 1 of Ref. [1]); as

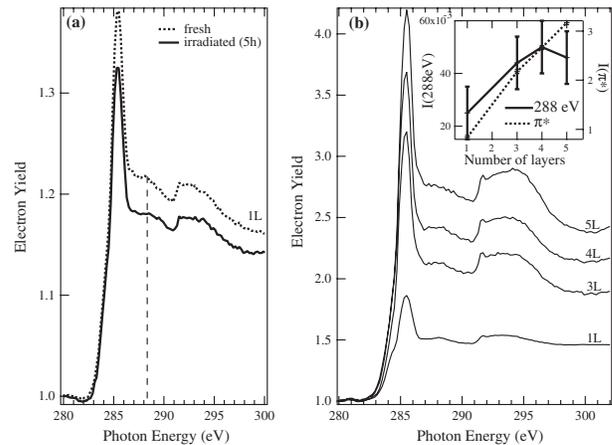


FIG. 1. C(K)-edge photoabsorption spectra of (a) graphene, 1st measurement (dotted line) and after 5 hours of continuous irradiation (solid line) and (b) graphene and FLG samples. In the inset, the intensity of electron yield of the π^* resonance (dotted line) along with the intensity of the peak at 288 eV (solid line) is reported.

reported in the inset, the intensity of the peak at 288 eV increases with the number of layers, suggesting that this structure cannot be ascribed to a surface contaminant.

In summary, our data and the published literature indicate that the 288 eV peak in the C K -edge NEXAFS spectra of graphene and FLG is an intrinsic feature of the graphite band structure, which we ascribe to the interlayer state.

D. Pacilé,¹ M. Papagno,¹ A. Fraile Rodríguez,² M. Grioni,³ L. Papagno,¹ Ç. Ö. Girit,^{4,5} J. C. Meyer,^{4,5} G. E. Begtrup,^{4,5} and A. Zettl^{4,5}

¹INFN and Dipartimento di Fisica, Università della Calabria 87036 Arcavacata di Rende, Cosenza, Italy

²Swiss Light Source, Paul Scherrer Institut 5232 Villigen PSI, Switzerland

³IPN, Ecole Polytechnique Fédérale de Lausanne (EPFL) CH-1015 Lausanne, Switzerland

⁴Department of Physics, University of California Berkeley, California 94720, USA

⁵Materials Sciences Division Lawrence Berkeley National Laboratory Berkeley, California 94720, USA

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