Exploiting the self-organization in 2D structures

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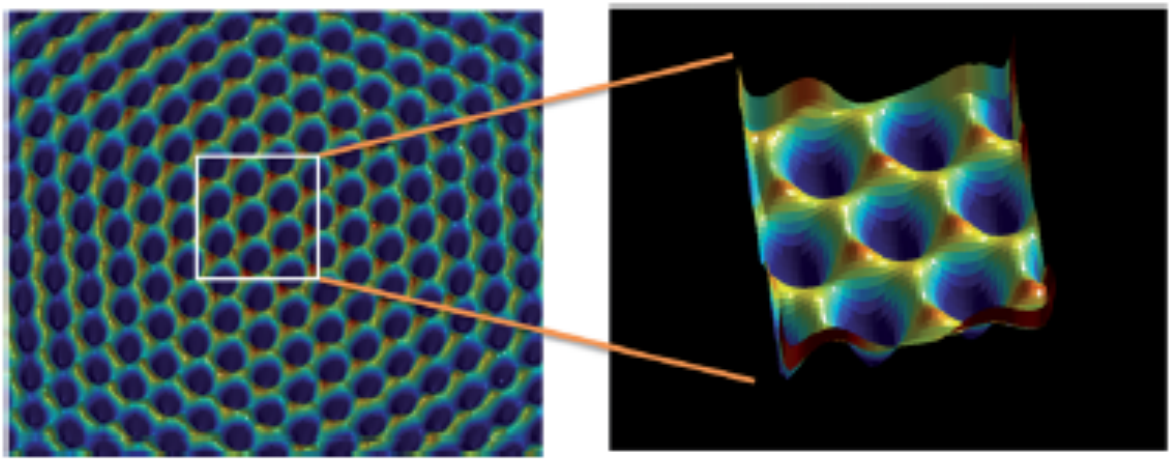
In a 2D self-organized crystalline structure more than 1000 unit cells can be observed in a single image. Here we exploit the benefits from having a large number of observations of the same unit cell utilizing an image processing methodology. We obtain sub-picometer resolution data from a 50 pm image of graphene, revealing a 1% axial elongation and a 3 fold symmetry, indicating a chair conformation.

The image processing methodology can also quantify the degree of overall self-organization in structures that display local but not necessarily long range order. This is illustrated by the analyses of 4 hexagonally packed 2D structures with different degrees of long range order. In each case, we analyze the image of the 2D structure and extract a number of relevant structural parameters, among which the degree of self-organization, with which we characterize and compare the individual structures. In the case of disordered structures, we show that our methodology has distinct advantages over Fourier based methods. In all 4 cases we have a large number of individual unit cells that our methodology can superimpose, and structural details can be extracted with a precision of approximately 0.01 - 0.02 pixel. In one of our samples this resulted in sub-picometer resolved structural details. In the case where the objects with varying size self-organize, our data shows that objects of similar size tend to be neighbors in agreement with both theory and empirical observations.



Sub-picometer structural information of graphene hidden in a 50 pm resolved image By: Petersen, Steffen B.; Gajula, Gnana Prakash; Neves-Petersen, Maria Teresa NANOSCALE Volume: 5 Issue: 19 Pages: 8874-8878 Published: 2013