Scale-dependent fragmentation mechanism of two-dimensional materials

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The physics of fragmentation is of interest for different fields of science and engineering; the size distribution of 3-dimensional (3D) fragments is typically studied in materials science, military applications or astronomy; size distribution of (1D) polymer chains is studied instead in polymer science. Here, we model the physics of fragmentation in two dimensions (2D) using as an ideal system graphene oxide monoatomic nanosheets. Thanks to automatic image processing and statistical modelling we are able to discriminate two different fragmentation processes in 2D: "bulk" fragmentation and "edge" fragmentation, acting on different scales, following gamma and exponential distributions respectively. We can define in this way the area polydispersity in two dimensions and demonstrate (in analogy with polymer metrology) that this parameter is proportional to light scattering of 2D materials in solution.

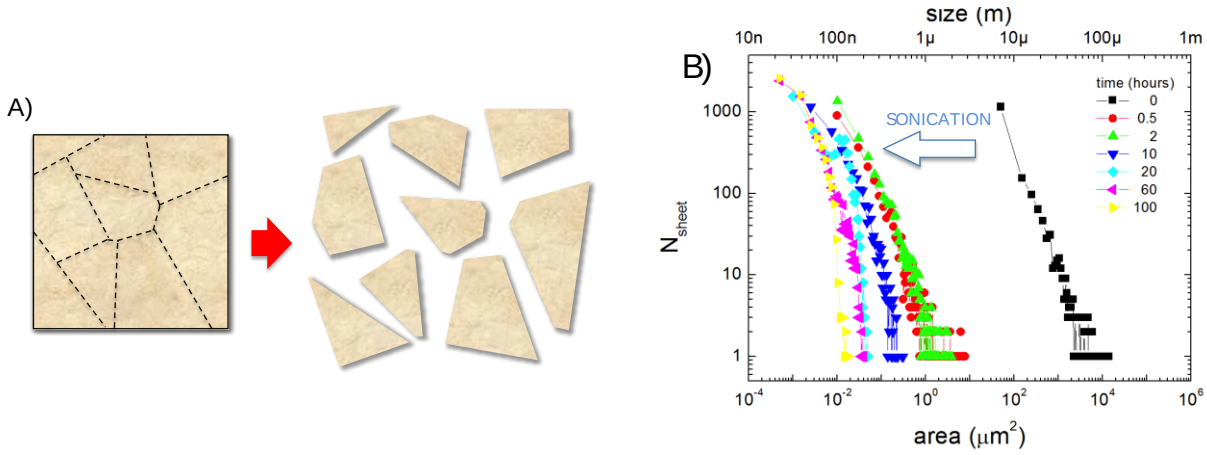

Fig. 1 A) Schematic representation of one of the different fragmentation mechanisms observed. B) Evolution of size distribution of the 2D nanosheets for different sonication times, plotted in log-log scale.

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