



Dimensional changes in nanomaterials through pressure application and the contribution of Raman spectroscopy

Dr. Alfonso San-Miguel

Institut Lumière Matière - Université de Lyon

Pressure is a three-dimensional concept. When applied to low-dimensional systems there is a general trend towards system dimensionality increase. Such evolution can manifest in very different ways involving either bond reconstruction, nanostructure fragmentation or geometrical changes. The prototypical case of nanoscale high pressure dimensional modification is fullerene polymerization under extreme conditions. Here we will concentrate on less obvious mechanisms leading to dimensionality evolution in nanomaterials. We will for this consider the high pressure behavior of carbon and BN nanotubes (1D) and graphene and atomic-thick MoS_2 (2D) in different environments.

After considering the generalization of the fullerene (0D) polymerization mechanism for dimensionality change in other 1D and 2D systems [1,2], we will review dimensionality modifications in intercalated/filled nanosystems [3-5], 1D to 2D changes due to the geometrical evolution of carbon nanotubes [6-9] and h-BN nanotubes [10] or 2D to 3D changes related to the interaction with the environment of graphene and other 2D-systems [11-13] (Fig 1).

Finally, the opportunities offered by dimensionality tuning for the development of a pressure mediated nano-engineering will be discussed [14] including the case of nanocomposites [15].

The dimensional analysis will be supported by the complementary studies through *in situ* high pressure Raman spectroscopy, *ex situ* HRTEM observations and atomistic modelling of the different systems.

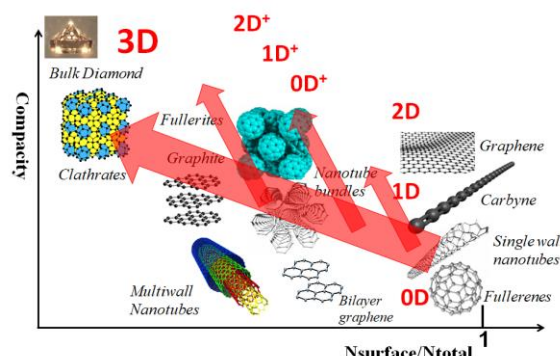


Figure 1. Scheme of high pressure dimensionality evolution in carbon based nanomaterials.

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