Graphene : From Flatland to the Future…

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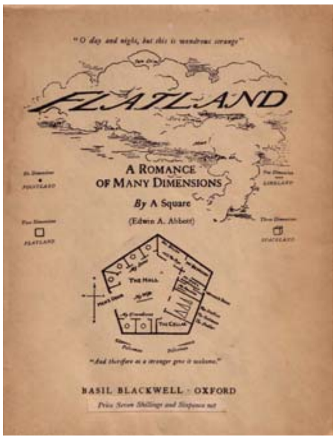
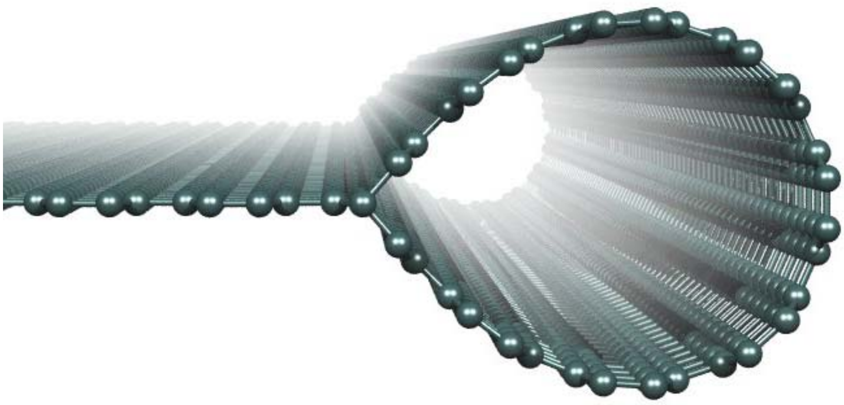
Graphene is the new much-hyped "wonder material" at the centre of the 2010 Nobel Prize for Physics. Originally predicted to be both flat and theoretically impossible to create, graphene has surprised us on both counts. In this talk I will briefly present Graphene, some of its history and unique properties, and show both its promise for the future and some of the challenges if it is to live up to its promise as the defining material of the 21st century.

At the IMN we have an active research programme modelling graphene at the atomic scale. Conventional three-dimensional crystal lattices are terminated by surfaces, which can demonstrate complex rebonding and rehybridisation, localised strain and dislocation formation. Two dimensional crystal lattices, of which graphene is the archetype, are terminated by lines. The additional available dimension at such interfaces opens up a range of new topological interface possibilities. We show that graphene sheet edges can adopt a range of topological distortions depending on their nature. Rehybridisation, local bond reordering, chemical functionalisation with bulky, charged, or multi-functional groups can lead to edge buckling to relieve strain [1], folding, rolling [2] and even tube formation [3]. We discuss the topological possibilities at a 2D graphene edge, and under what circumstances we expect different edge topologies to occur.





[1] Ph. Wagner, *et al*, PRB 84 (13) 134110 (2011)
[2] V. Ivanovskaya, *et al*, Proc. GraphITA 2011, 75 (2012)
[3] V. Ivanovskaya, *et al*, PRL 107, 065502 (2011).