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Carbon Nanotubes: On the Origin of Helicity

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The mechanism of helicity formation of carbon nanotubes still remains elusive that hinders their applications. Current explanations mainly rely on the planar interrelationship between the structure of nanotube and corresponding facet of catalyst in 2D geometry that could amend the structure of grown carbon layer, specifically due to the epitaxial interaction. Yet, the structure of carbon nanotube and circumference of the rims assume involvement of more than one facet i.e. it is 3D problem. By aiming this problem we find that the nanotube nucleation is initiated by cap formation via evolving of graphene embryo across the adjacent facets of catalyst particle. As a result the graphene embryos incorporate in their hexagonic network various polygons to accommodate the curved 3D geometry that initiates cap formation following by elongation of the circumferential rims. Based on these results, also on the census of nanotube caps and the fact that given cap fit only one nanotube wall, we consider carbon cap responsible for the helicity of carbon nanotube. This understanding could provide new avenues towards engineering particles to explicitly accommodate certain helicities via exploitation of the angular distribution of catalyst adjacent facets. Our recent progresses in production of carbon nanotubes, nanotube reinforced composites and their potential applications also will be presented.