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Producing Carbon Nanoparticles from Agricultural and Municipal Wastes

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Abstract : In the year of 2011, the global production of carbon nano-materials (CNMs) was around 3,500 tons, and it is projected to expand at a compound annual growth rate of 30.6%. Expanding markets for applications of CNMs, such as carbon nano-tubes (CNTs) and carbon nano-fibers (CNFs), place ever-increasing demands on lowering their production costs. Current technologies for CNM generation require intensive premium feedstock consumption and employ costly catalysts; they also require input of external energy. Industrial-scale CNM production is conventionally achieved through chemical vapor deposition (CVD) methods which consume a variety of expensive premium chemical feedstocks such as ethylene, carbon monoxide (CO) and hydrogen (H2); or by flame synthesis techniques, which also consume premium feedstock fuels. Additionally, CVD methods are energy-intensive. Renewable and replenishable feedstocks, such as those found in municipal, industrial, agricultural recycling streams have a more judicious reason for usage, in the light of current emerging needs for sustainability. Agricultural sugarcane bagasse and corn residues, scrap tire chips as well as post-consumer polyethylene (PE) and polyethylene terephthalate (PET) bottle shreddings when either thermally treated by sole pyrolysis or by sequential pyrolysis and partial oxidation result in the formation of gaseous carbon-bearing effluents which when channeled into a heated reactor, produce CNMs, including carbon nano-tubes, catalytically synthesized therein on stainless steel meshes. The structure of the nano-material synthesized depends on the type of feedstock available for pyrolysis, and can be determined by analysing the feedstock. These feedstocks could supersede the use of costly and often toxic or highly-flammable chemicals such as hydrocarbon gases, carbon monoxide and hydrogen, which are commonly used as feedstocks in current nano-manufacturing process for CNMs.

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