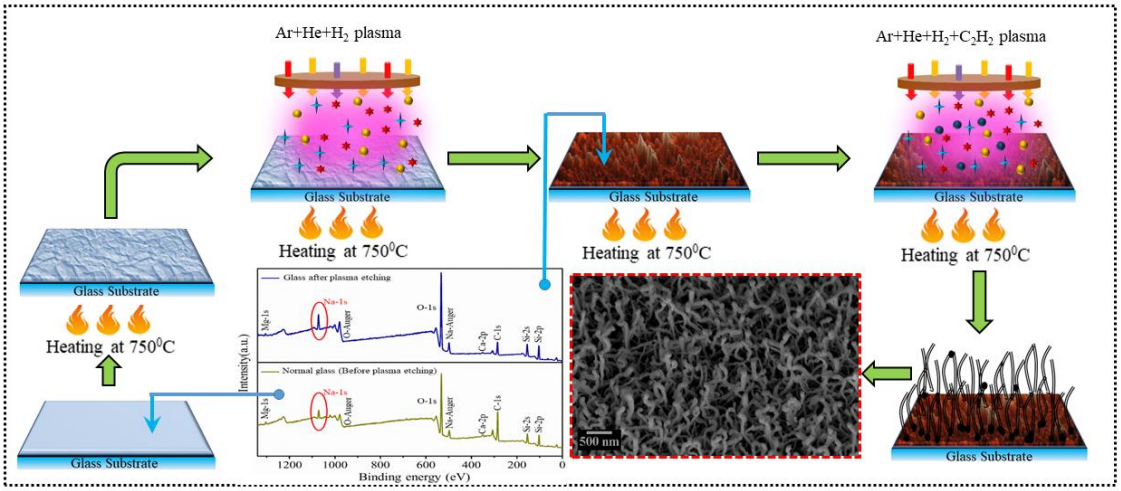
A Process for Single-step Synthesis of Carbon Nanotubes on Glass Substrate

Brief description:

It is a process that utilizes the Na present in the soda-lime glass as a catalyst to facilitate carbon nanotube growth by single-step atmospheric pressure PECVD.

Details about the technology:

This invention relates to the direct preparation of carbon nanotubes (CNTs) on a glass substrate using a hollow cathode discharge atmospheric pressure plasma-enhanced chemical vapor deposition (PECVD) process. This approach aims to overcome the limitations of existing methods, such as complex preparation procedures, the use of transition metal catalysts, and the requirement for high temperatures exceeding 1000 °C. Use of Na as a catalyst facilitates easy cleaning of the nanotubes through washing with water.



Schematic of the carbon nanotube synthesis process

The methodology of this process involves the following steps:

i) Substrate heating and pre-plasma treatment of the glass substrate are carried out in a specially designed plasma reactor. This treatment facilitates the enrichment of sodium (Na) at the surface of the glass substrate.

ii) To initiate CNT growth in a single-step, acetylene (C_2H_2) gas is introduced into a pre-existing radio-frequency (RF) plasma composed of argon (Ar), helium (He), and hydrogen (H_2)

inside the plasma chamber. The energetic electrons in the RF plasma dissociate the injected C_2H_2 gas, generating reactive carbon species. These species contribute to the formation of CNTs, with the Na present in the glass substrate acting as a catalyst in the growth process.

What problem it solves/applicability of the technology:

This process addresses key challenges in carbon nanotube synthesis by eliminating the need for external metal catalysts. The plasma pre-treatment enhances surface activation and Na exposure, offering a simpler route to efficient substrate-induced catalysis without extra processing steps. Instead, the inherent Na in the glass substrate acts as a catalyst, enabling CNT growth under atmospheric pressure conditions and significantly reducing infrastructure and operational costs. Unlike traditional methods that require complex purification techniques, sodium catalyst can be easily removed by simple washing with deionized water, resulting in clean CNTs. The process also achieves uniform CNT growth across the entire glass substrate, supporting scalable applications in advanced devices.

Patent status:

Title of Patent: *A process for single-step synthesis of carbon nanotube on glass substrate*

Patent Assignee: IASST, Guwahati

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