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Applied Physics Letters

Volume 109, Issue 8, 22 August 2016, Article number 081604

Micro glow plasma for localized nanostructural modification of carbon nanotube forest (Article)

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Abstract

This paper reports the localized selective treatment of vertically aligned carbon nanotubes, or CNT forests, for radial size modification of the nanotubes through a micro-scale glow plasma established on the material. An atmospheric-pressure DC glow plasma is shown to be stably sustained on the surface of the CNT forest in argon using micromachined tungsten electrodes with diameters down to 100 μm. Experiments reveal thinning or thickening of the nanotubes under the micro glow depending on the process conditions including discharge current and process time. These thinning and thickening effects in the treated nanotubes are measured to be up to ~30% and ~300% in their diameter, respectively, under the tested conditions. The elemental and Raman analyses suggest that the treated region of the CNT forest is pure carbon and maintains a degree of crystallinity. The local plasma treatment process investigated may allow modification of material characteristics in different domains for targeted regions or patterns, potentially aiding custom design of micro-electro-mechanical systems and other emerging devices enabled by the CNT forest. © 2016 Author(s).

Indexed keywords

Engineering controlled terms: Atmospheric pressure; Electric discharges; Electrodes; Forestry; Machine design; MEMS; Nanotubes; Plasma applications; Yarn

Degree of crystallinity; Discharge currents; Micro electro mechanical system; Modification of materials; Selective treatment; Size modification; Tungsten electrodes; Vertically aligned carbon nanotube

Engineering main heading: Carbon nanotubes

ISSN: 00036951 **CODEN:** APPLA **Source Type:** Journal **Original language:** English
DOI: 10.1063/1.4961629 **Document Type:** Article
Publisher: American Institute of Physics Inc.

Funding details

Funding number	Funding sponsor	Acronym
	Canada Foundation for Innovation	CFI
STPGP 396817-10	Natural Sciences and Engineering Research Council of Canada	NSERC

Funding text

This work was partially supported by the Natural Sciences and Engineering Research Council of Canada (Strategic Project Grants program, STPGP 396817-10), the Canada Foundation for Innovation, and the British Columbia Knowledge Development Fund. K. Takahata was supported by the Canada Research Chairs program.

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