Growth of Porous Films Orderly Stacked by Nanoballs with Various Sorts Carbons

Yen-Feng Li, Fu-Der Lai

Institute of Photonics Engineering, National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan (ROC).

Corresponding author's e-mail: *fdlai@nkust.edu.tw*

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ABSTRACT

A novel synthesis technique, termed "nanoball-layer printing," was introduced. "Nanoball-layer Printing" doesn't refer to a direct printing process using nanoballs (NBs). It is a layer synthesis method where a NB film, a new nanostructured material, is produced via physical vapor deposition coating and subsequent heat treatment, during which Cu_3Si acts as a potent catalyst, prompting carbon (C) atoms to diffuse across the Cu_3Si grain boundary and form graphene quantum dots (GQDs). This method constitutes the film's layer-by-layer synthesis process. The NBs from one layer align orderly with those of the adjacent layer, analogous to atomic structures in crystals. The porous ordered nanostructured carbon nanoballs (CNB) and carbon-graphene quantum dots (C-GQD) hybrid NB (CGHNB) films were synthesized and analyzed. Three domains are focused: 1. Detailed Exploration of CNBs Synthesis: Examination of the formation of porous carbon films, orderly stacked with CNBs, detailing the synthesis procedures of CNBs. 2. Incorporation of GQDs into CNBs: Study of the synthesis of CGHNBs enriched with fine pores, representing a family of 3D graphene by integrating a substantial quantity of GQDs with CNBs. 3. Analytical Scrutiny of CNB and CGHNB (TCNB) Films: A detailed investigation into the properties of TCNB films, orderly stacked layer-by-layer with NBs. The CGHNB film had been employed as the electrode in LIB charging experiments, yielding notable results. The carbon-based TCNB films, endowed with nanostructures and porosity, hold promise in various domains such as energy storage, sensors, computing, and notably SERS biosensors.

Keywords: NB-layer Printing, Porous Film, Nanostructure, Carbon NB, Graphene Quantum Dot

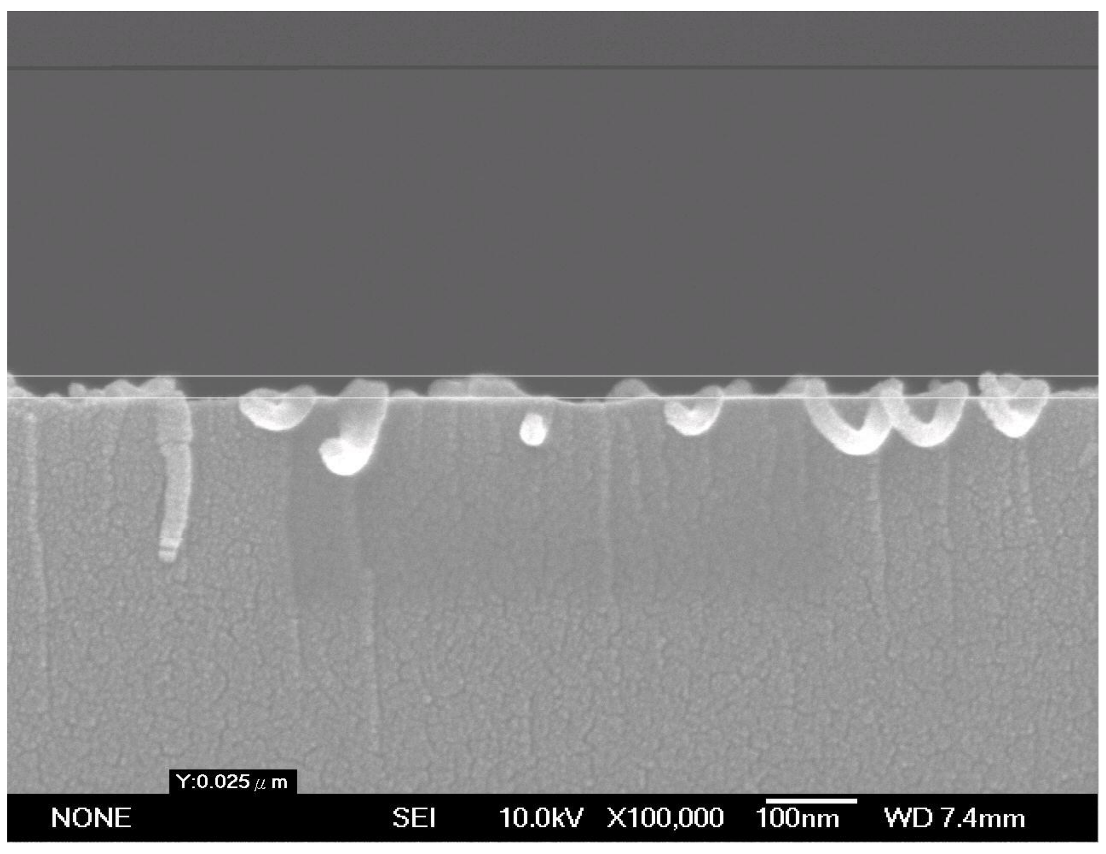

Fig.1 FESEM images of the CNB films after coating of 5 Sec. and the annealing temperatures of 900°C.

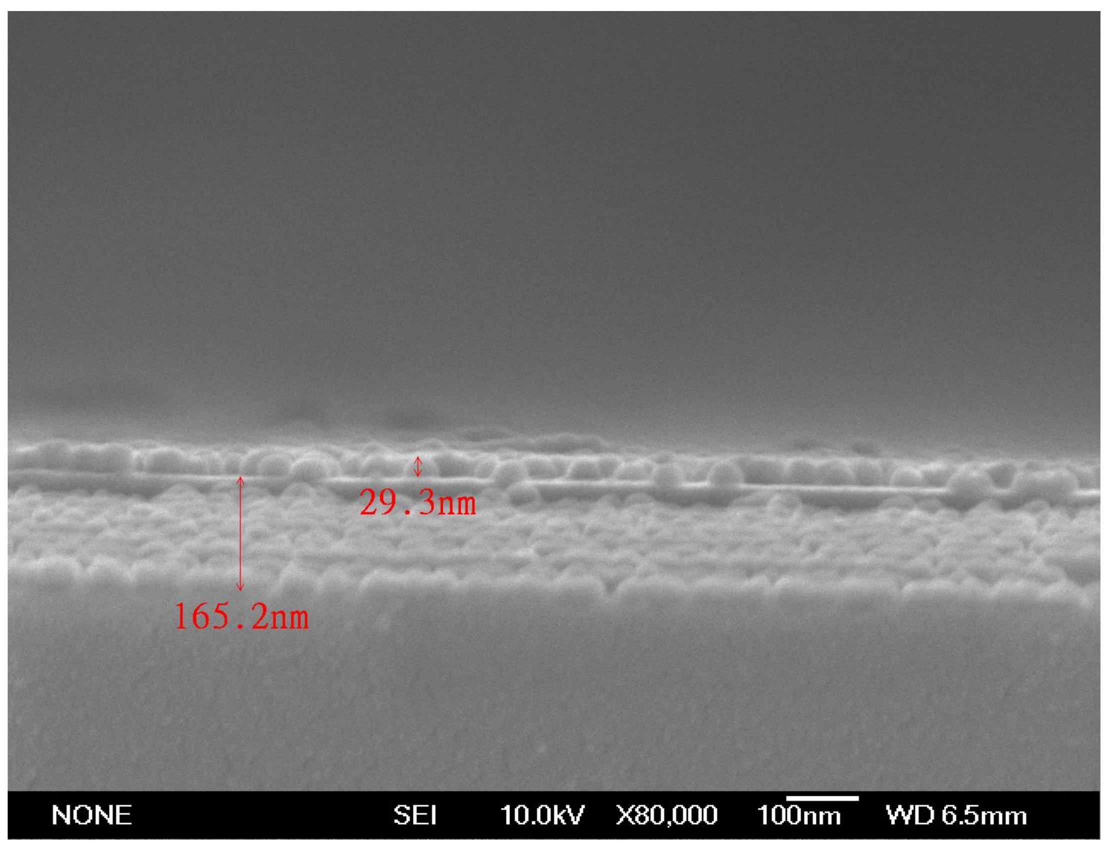

Fig.2 FESEM images of the CNB films after coating of 20 Sec. and the annealing temperatures of 900°C.

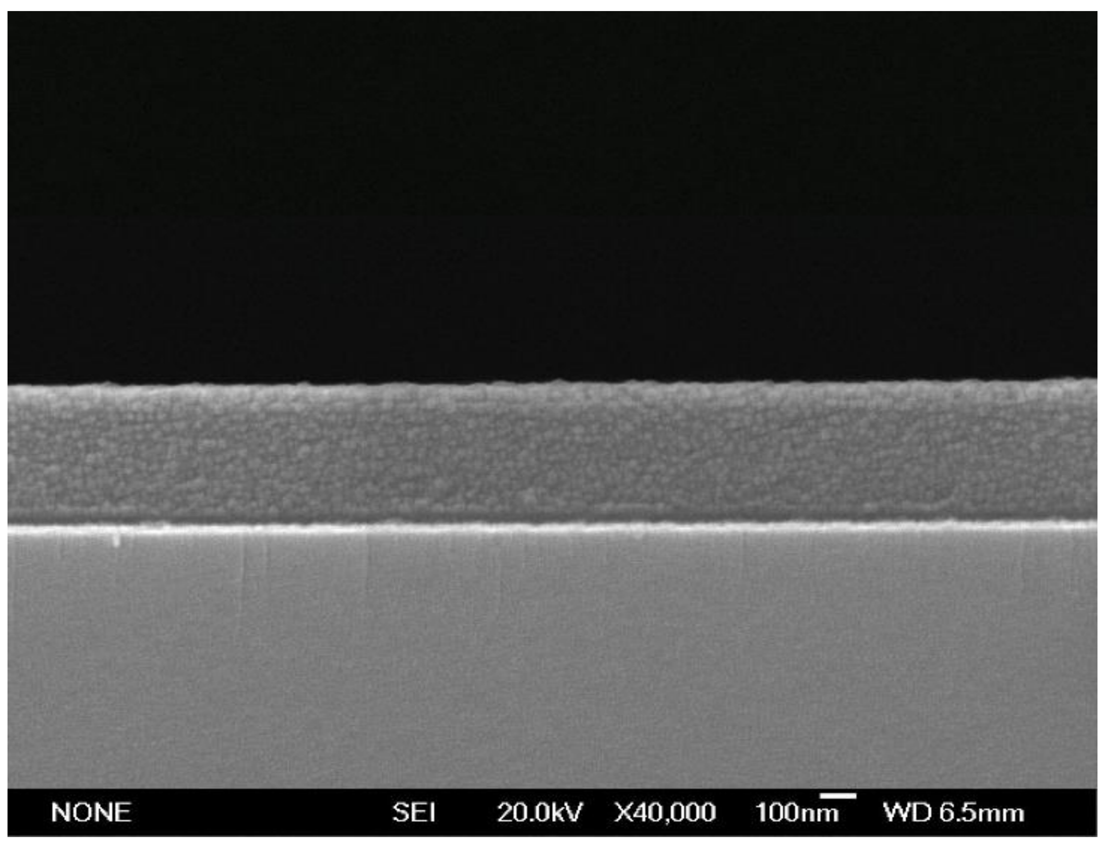

Fig.3 FESEM images of the CNB films after coating of 180 Sec. and the annealing temperatures of 900°C.

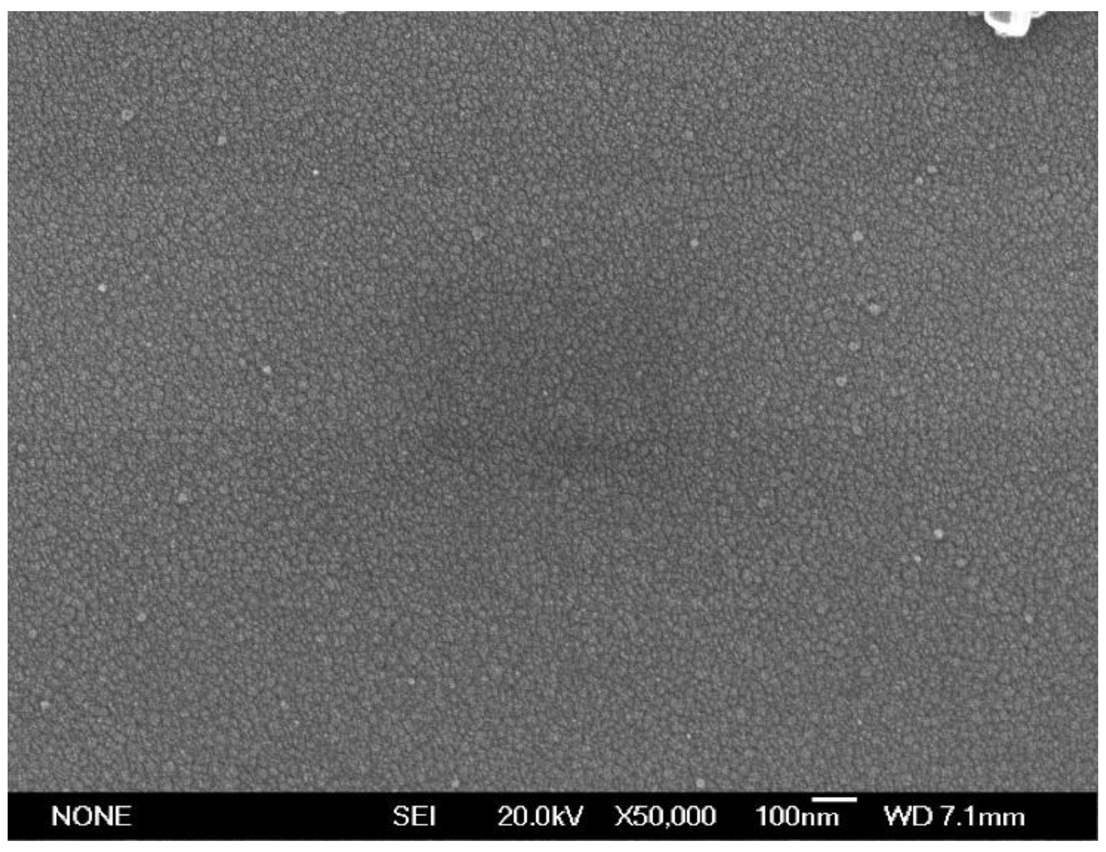

Fig.4 FESEM images of the CNB films after coating of 180 Sec. and the annealing temperatures of 900°C.

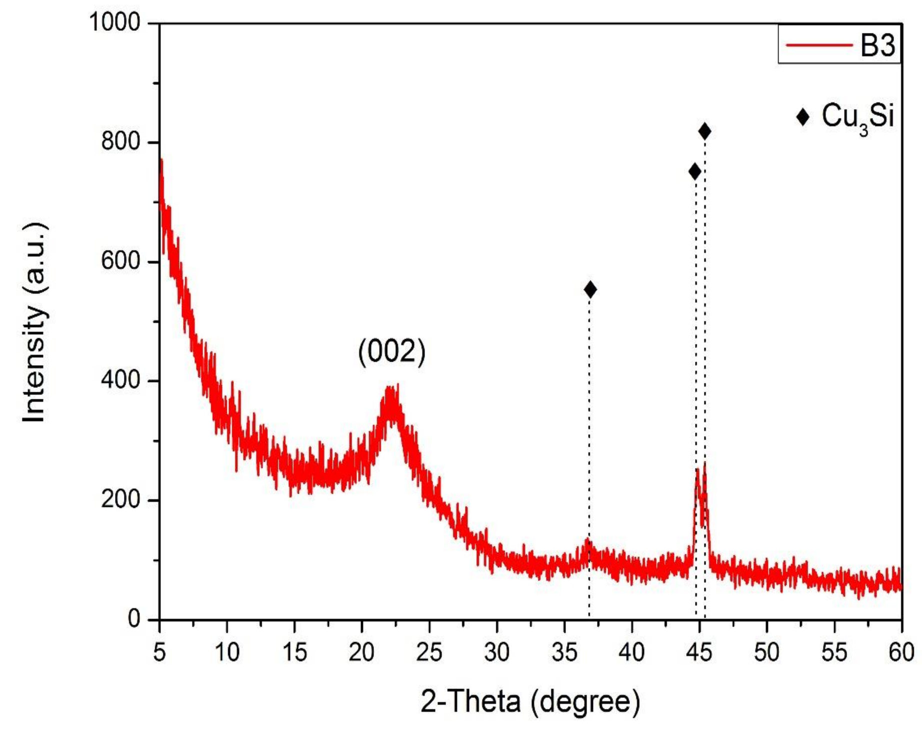

Fig.5 XRD pattern of the Cu-C mixed layer/Si layer/substrate after the annealing temperatures of 900℃.

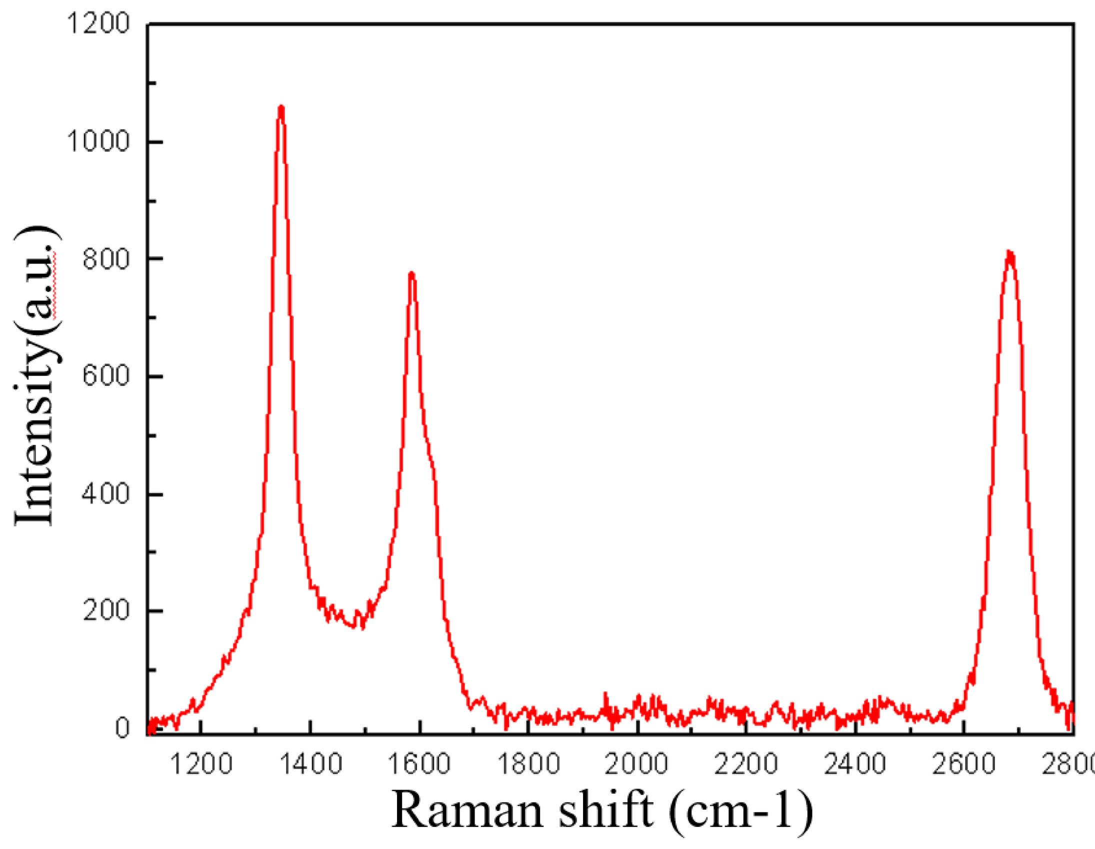

Fig.6 Raman spectra of the CGHNB films after the annealing temperatures of 900℃