Hydrogenated Amorphous Carbon Nitride Films with Controlled Hydrogen Densities—Application to Electric Field Emission Devices

Haruhiko Ito*, Yukihisa Kogure, Satoshi Oki and Hidetoshi Saitoh
Department of Chemistry, Nagaoka University of Technology,
Kamitomioka, Nagaoka, Niigata 940-2188, Japan
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Hydrogenated amorphous carbon nitride films which presumably include oxygen atoms (a-CNx:(O):H) were prepared by the electron cyclotron resonance (ECR) plasma chemical vapor deposition (CVD) of mixed gases of He, BrCN, and H2O. The partial pressures of He and BrCN were 3 and 2 mTorr, respectively. The relative number density of the hydrogen atoms was varied by controlling the partial pressure of H2O (P_{H2O}) in the range of 0.0–0.6 mTorr. The films were coated by ECRCVD onto Al-doped ZnO (ZnO:Al) single crystal whiskers, which were prepared by atmospheric CVD with the reactants of Zn(C5H7O2)2 and Al(C5H7O2)3, to manufacture cold cathode devices. The I-V characteristics of the devices were confirmed to be the Fowler-Nordheim type, and the work functions were determined to be 4.7±0.4, 2.3±0.1, 2.0±0.1, and 1.9±0.1 eV under the conditions of P_{H2O} values of 0.0, 0.2, 0.4, and 0.6 mTorr, respectively.

*Corresponding author: e-mail: bu7dd8@nagaokaut.ac.jp