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ABSTRACT PROCEEDINGS



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Field Electron Emission Characterisation of the SiC Nanowires Made by CaSi₂/PTFE Combustion Synthesis

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Summary: SiC nanowires produced by Ca/Si₂/PTFE combustion synthesis have been used as field electron emitters. Obtained results show the emission properties comparable with carbon nanotubes one. The $I=f(E)$ characteristics show effects which may be caused by the quantum mechanism of electrical carrier transport.

Keywords: SiC nanowires, combustion synthesis, field electron emitters

Results

SiC nanowires (SiCNWs) made by CaSi₂/PTFE combustion synthesis [1,2] were randomly deposited by putting a drop of the SiCNWs/1,2-dichloroethane suspension onto silicon substrates of both n- and p-type (Fig.1).

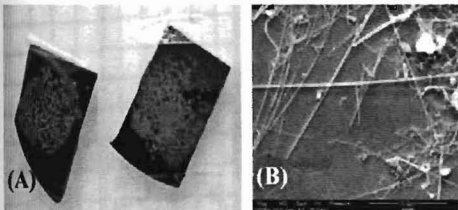


Fig. 1. The Si substrates with SiCNWs coating (A) and SEM micrograph of the SiC nanowires (B).

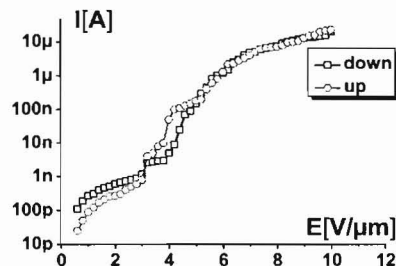


Fig. 2. The step-like features of the $I=f(E)$ characteristics for the SiCNW emitter.

Field electron emission tests were carried out in a diode configuration with a spherical anode of ≈ 5 mm radius placed 20 – 70 μm above the emitting surface. The emission characteristics revealed a threshold field E_{th} within the (2.5 - 3.5) $\text{V}/\mu\text{m}$ range. This is comparable with the threshold values obtained for carbon nanotube emitters [3]. The observed influence of the substrate type on field electron emission was that the threshold field was slightly

lower for the nanowires deposited on the n-type Si (2.5 to 3.0 V/ μm) than for the p-type one (3.0 to 3.5 V/ μm). Because the SiCNWs are probably n-type semiconducting [2] the formation of p-n junction between p-type Si and SiCNW is plausible. Some of the $I=f(E)$ characteristics exhibited pronounced step-like features (Fig. 2). Their appearance can be attributed to the quantum transport mechanism of electrical carriers in the narrow nanorod structures [4]. The field enhancement factors β ranged from about 800 to about 2000 which was rather small value as expected for nanorod structures. However, in our opinion it was due to the fact that the SiCNWs were mostly horizontally oriented on the samples. There is the need for the improved method which could allow the SiCNWs to be vertically oriented, e.g. by deposition in a strong electric field.

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