

SYNTHESIS OF CARBON NANOTUBES ON SEYMCHAN METEORITE SURFACE

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Introduction: Synthesis of carbon nanotubes (CNT) with chemical vapor deposition (CVD) technique requires substrates which contain nanometer-size metal particles. Most commonly-used metals are Fe, Co, Ni, because of high solubility of carbon in these metals at high temperatures and high carbon diffusion rate in these metals [1].

The metal part of Seymchan (PMG) is suitable to such experiments. It consists of Ni and Fe and there are nanometer-size cloudy zones in plessite [2]. Furthermore, meteorite contains zones with different nickel content. It allows us to determine the influence of different Fe-Ni alloys on CNT synthesis in single experiment.

Experimental: Samples of the meteorite were prepared with the standard method of preparation of thin sections and were etched with a 2% nital. They were observed with optical microscope ZEISS Axiovert 40 MAT and scanning electron microscope ZEISS SIGMA VP. CNT were grown with Device of carbon nanotube growth "CVDomna". A vapor-gas mixture of ethanol and oxygen was passed in reaction chamber. The ethanol pyrolysis was carried out at a temperature of 600°C and a pressure of 15 kPa for 5 minutes. Then samples were cooled in a thin atmosphere. CNT were observed with SIGMA VP scanning electron microscope. Ni content was analyzed with Energy-dispersive X-ray spectroscopy.

Results: Samples of Seymchan meteorite had Widmanstätten Structures, which is the arrangement of kamacite lamellae exsolved within taenite [3]. It was 6.5–7.2 wt.% Ni in kamacite and 15.7–41 wt.% Ni in plessite. Cloudy zones could be found along tetraenaite rim on boundaries between kamacite and plessite fields. It composed of two phases: the high-Ni and the low-Ni that form 80–230 nm islands.

Observation of CNT showed that there is a difference between CNT, which were synthesized on kamacite, and plessite (Fig.1). CNT with low aspect ratio (4 - 6) were obtained on kamacite. CNT with high aspect ratio (more than 10) were obtained on plessite. The nanotubes were not synthesized on the tetraenaite surface. We propose that this fact depends on grain size. Production of nanotubes requires nanosize particles as a catalyst, coarse-grained substrate cannot be a catalyst for CNT growth. The diameters of the CNT were measured. These values range from 90 to 240 nm. It should be noted that cloudy zone islands size is in same range. This correlation can mean that cloudy zone particles was CNT nucleus.

Preliminary results of researching of Fe-Ni substrate influence on the CNT synthesis with CVD-method were represented in this work.

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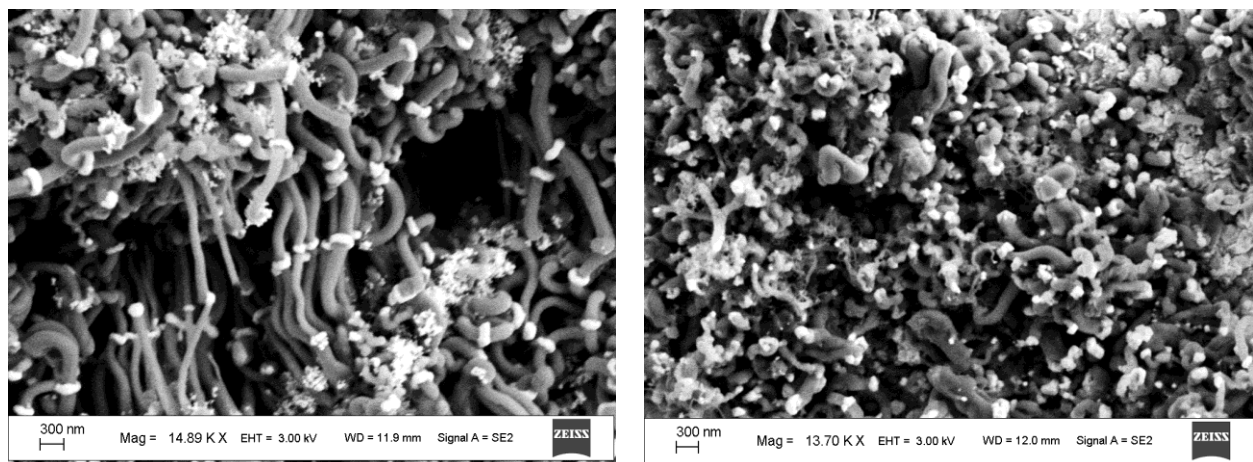


Fig. 1 – SEM image of CNT on the plessite (left) and kamacite (right)