

# Compact chemical vapor deposition system with embedded scanning probe microscope for *in-situ* study of material growth

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The chemical vapor deposition (CVD) setup combining reactor and scanning probe microscope (SPM) was developed using principles described earlier [1,2]. Exceptional feature of the created setup is its ability to provide *in-situ* measurements during deposition process.

A key problem solved in this work is construction of sample holder providing ability for isolation of the SPM body from the heated up to 1200 °C sample. The holder was made as a cylinder of aerogel (SiO<sub>2</sub> with extremely high porosity). The sample temperature was ensured by Joule heating of a chip produced from standard 500µm thick Si wafer with two molybdenum wires used as electrodes to supply electric current. The whole system was attached to the sample holder made from quartz plate. The photo images of the CVD reactor chamber and its reactive zone are shown in Fig.1. Thin Ni substrate was located on the heater and supported by molybdenum wire (see Fig.1a). Moreover, besides fixation this wire simultaneously plays a second important role – it supplies tunnel voltage to the substrate.

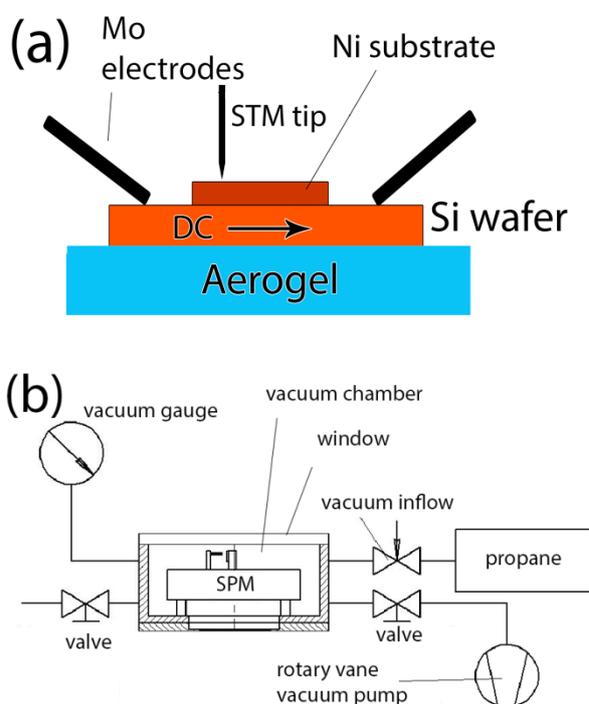
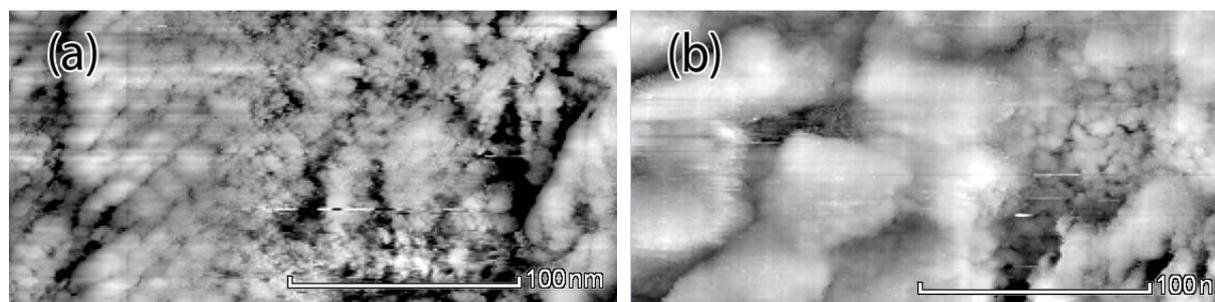


Fig. 1. (a) – scheme of the sample holder with embedded heating system ; (b) – scheme of the CVD system with embedded STM

Preliminary results of *in-situ* measurements demonstrate ability of the system for detection carbon deposits formed on substrate. Typical examples of the STM images obtained during *in-situ* measurements are presented in Fig. 2. The STM images of nickel substrate were obtained from the same regions of the substrate before and after 3 min CVD process. Thermal CVD process was realized by heating Ni substrate up to 700-800 °C in propane gas atmosphere at 6 mbar pressure.



**Fig. 2.**

(a) – STM image of Ni sample before heating; (b) – STM image of Ni sample in a same place after 3 min heating in propane

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[1] A. B. Loginov, R. R. Ismagilov. Designing a scanning probe microscope for in situ study of carbon materials growth processes during chemical vapor deposition. *Journal of Nanophotonics*, 11(2017)032509.

[2] A.N. Obraztsov, A.A. Zolotukhin, A.O. Ustinov, A.P. Volkov, Yu.P. Svirko. Chemical vapor deposition of carbon films: in-situ plasma diagnostics. *Carbon* 41 (2003) 836.