Optical emission spectroscopy study of microwave plasma in methane-Hydrogen-silane mixtures in process of SiC and composite SiC-diamond films deposition [[1]](#footnote-1)\*)

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1Yurov V.Yu., 1,2Ralchenko V.G., 1Martyanov A.K., 1,2Antonova I.A., 1Sedov V.S., 1Shevchenko M.Y. and 1Bolshakov A.P.

1Prokhorov General Physics Institute, Russian Academy of Sciences, Vavilov str. 38, Moscow 119991, Russia, [office@gpi.ru](mailto:office@gpi.ru)  
2National Research Nuclear University MEPhI, 31 Kashirskoyeshosse, Moscow, 115409, Russia, [info@mephi.ru](mailto:info@mephi.ru)

Microwave plasma chemical vapor deposition (MPCVD) in silane-hydrogen and silane-hydrogen-methane mixtures is effectively used for growth of SiC and SiC-diamond composite films [1], however, the properties of the silane-containing MW plasma at pressures of the order of 100 Torr still are poorly explored. Here we characterize the MW plasma (2.45 GHz) in SiH4+H2 and SiH4+СH4+H2 mixtures (72 Torr) with silane concentration in the process gas ranging from zero to 5% using high resolution optical emission (OE) spectroscopy. Besides the OE lines of C2 dimer, Balmer series of excited atomic hydrogen Hα, Hβ, Hγ, Hδ, Hε, and CH radical we observed atomic Si lines at 263, 288 and 391 nm and a relatively weak SiH emission, the Si atoms being the main Si-related specie in the plasma (Fig. 1a). Gas temperature *Tg* of ≈3160 K was estimated from intensities of rotational lines of C2 dimer (Δν=0, λ=516.5 nm) emission band. The absorbed microwave power density in the plasma wherein was between 36 and 43 W/cm3 with a slight tendency to decrease with silane addition. The intensities of H, C2 and Si lines in the OE spectra show an obvious kink of slope at ≈0.5%SiH4 on the plot vs silane concentration in H2 and H2 + CH4 mixtures (Fig. 1b). Also, the microwave power density, *Tg*, and intensity ratio Hα/Hβ (sensitive to electronic temperature *Te*) all show a clear extremum near the critical point at ≈0.5%SiH4. We will discuss possible reasons for the observed dynamics of the plasma parameters, and will describe structure and properties of the grown 3C-SiC and SiC-diamond composite films.

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| **(a)** | **(b)** |
| Fig.1. (a) OE spectrum for the plasma in 1%SiH4+0.5%CH4+H2 mixture. (b) Intensities of emission lines of Si 288 nm, Si 391 nm, Hβ, Hγ and C2 (516 nm) vs silane content in SiH4+0.5%CH4+H2 mixture. | |

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References

1. V.S. Sedov, A.K. Martyanov, A.A. Khomich, S.S. Savin, V.V. Voronov, R.A. Khmelnitskiy, A.P. Bolshakov, and V.G. Ralchenko, Diam. Relat. Mater. 98, 107520 (2019).

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Lt/ru/FD-Yurov.docx) [↑](#footnote-ref-1)