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HYBRID PLASMA CHARACTERISTICS OBTAINED WITH THE PARTICIPATION OF MICROWAVE AND LASER RADIATION ^{*)}²Medvedev A., ²Avtaeva S., ²Dolomanova V., ¹Pinaev V.¹Kutateladze Institute of Thermophysics SB RAS, pinaev_vadim@mail.ru²Institute of Laser Physics SB RAS, arey100x@gmail.com

In order to expand the range of plasma parameters used for CVD synthesis of polycrystalline diamond films at atmospheric pressure, gas activation is performed using hybrid plasma generated by simultaneous participation of microwave radiation (2.47 GHz) and a CO₂ laser (10.6 μm) [1], which allows filling the windows of component parameters that arise with separate use of both microwave and laser plasma and have not yet been realized and studied in terms of efficiency, speed and quality of synthesis. Figures 1 and 2 show the characteristic line appearance for microwave plasma and plasma obtained with the combined use of microwave and laser radiation (LR) with a 15 mm aperture collimator in the gas mixture of the following composition: 95% H₂, 3% Ar, 2% CH₄. As can be seen, when LR is fed into microwave plasma, the line width increases by more than an order of magnitude, which corresponds to a significant increase in the plasma electron density.

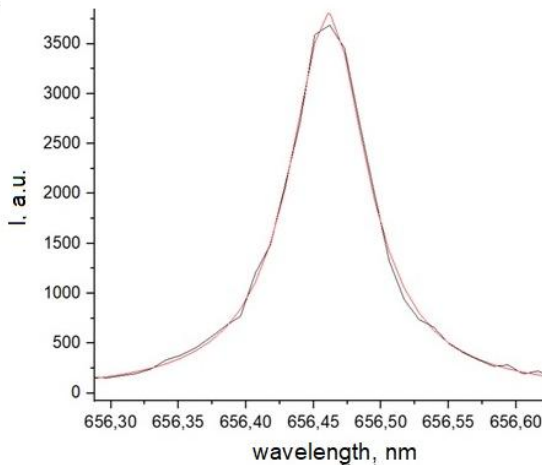


Figure 1. The appearance of the H_α line during microwave plasma generation with a pulse repetition rate of 1 kHz and a duty cycle of 5. The average microwave radiation power is 530 W. The experimental contour is approximated by the Lorentz function..

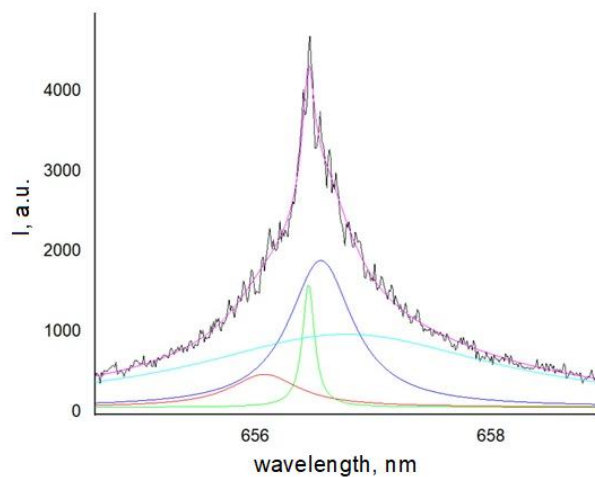


Figure 2. The appearance of the H_α line during plasma generation using two radiation sources – microwave and laser with a laser pulse repetition rate of 15 kHz. The average microwave power is 530 W, laser power is 800 W. The four-contour approximation is performed by the Lorentz function.

The paper investigates the role of ablation plasma in lines broadening, which occurs as a result of the action of LR on the molybdenum nozzle of a laser-plasma reactor. In addition to increasing the synthesis rate, feeding LR into the reactor allows doping the synthesized diamond films with metals, which is of decisive importance for the synthesis of nanocrystalline diamond films when creating antifriction coatings.

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References

[1]. Medvedev A., et al. XLVI Zvenigorod conference, 2019, 216.

^{*)} [abstracts of this report in Russian](#)