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SELF-REVERSED LINES OF ALKALINE METALS AND SOME OTHER ATOMS IN DISCHARGES INITIATED IN POWDER MIXTERS BY PULSED MICROWAVE PULSES OF A POWERFUL GYROTRON ^{*)}

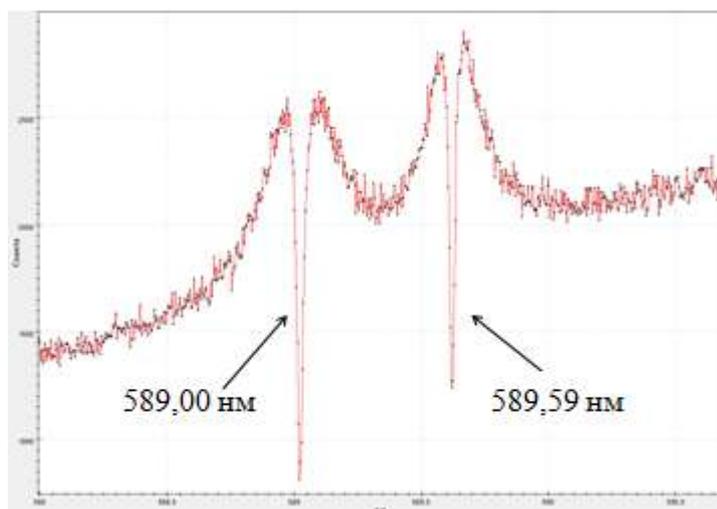
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Results are presented of optical measurement of self-reversed lines in spectral experiments on synthesis of micro and nanoparticles in microwave discharge. The discharges were initiated by pulsed radiation of a powerful gyrotron ($\lambda = 4$ mm, $t = 1\text{--}8$ ms, $P = 100\text{--}500$ kW) in thin layers of powder mixtures with a free surface.

In most discharges, lines of alkaline atoms are recorded that are capable of self-reversion, and which come from trace impurities that cannot be discovered by physical–chemical analyses.

Using spectral devices with sufficiently high resolution, characteristic details of the dynamics of these self-reversed lines were discovered, which can be used for quantitative diagnostics of such discharges. At some state of the discharge, in our case, at the stage close to its start, the amplitude



of the line reaches its maximum, after which, a depression appears in its center [1]. In this case, the maximum amplitude of the line corresponds to the radiation intensity of the black body. A typical radiation spectrum of the self-inversed characteristic binary line of sodium is shown in the figure.

The self-inversion is accompanied by a significant broadening of the lines which is, however, unconnected to the Doppler broadening or the force fields in the discharge; therefore, one should use such lines to calculate the parameters connected to the two above-mentioned

sources of line broadening with caution.

It is seen in the figure that depressions appear and rapidly increase in the centers of the lines. In this case, the center of the line is disappears completely, followed by the absorption of background radiation. The absorption of the background radiation makes it possible to estimate the density of atoms in the ground state. Usually, such situation arises after the microwave pulse was already switched off.

Spectra of Li, K, and Rb with pronounced self-inversion were also recorded, as well as those of Ca and Ag. A significant broadening of lithium line was found both when it is present as a trace admixture and as a salt and one of the main components of the powder mixture.

References

- [1]. Völker T., Gornushkin I.B. // *J. Anal. At. Spectrom.*, 2023, V. 38, P. 911–916.

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