HIGH-FREQUENCY PLASMA INTERACTION WITH SiO_2 GLASS

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Our work is concerned with the preparation and investigation of high-frequency light sources excited by means of outer electrodes, so called, electrodeless light sources (HFELS). The HFELS are widely used as bright radiators of narrow and intensive spectral lines covering spectral region from VUV to IR. The high-frequency electrodeless lamps are well suited for the investigation of the low-temperature plasma interaction with the lamp bulb walls due to the absence of electrodes, whose influence is difficult to take into account. High frequency (HF) electromagnetic field is applied to induce an inductive coupled discharge. The trend in modern light source development clearly points towards miniaturization, with the effect of higher radiation intensity from the lamp, also combined with demands of higher lifetime. The large diversity of lamp applications requires that there have to be specific properties of the used envelope material, which in practice causes such problems as wall corrosion and blackening, layer formation, solarisation and UV radiation resistance, increased ignition voltage, luminescence, out-diffusion of filling components, etc. [1] .

The task of the inventors and manufacturers of the light sources is to minimize this influence by appropriate choice and improvements of materials and technologies to make the bulbs working longer and to avoid the changes of spectral qualities with age.

The inner surfaces of lamps' walls were investigated depending on treatment: (1) pumping out; (2) vacuum-thermal cleaning; and (3) training with HF discharge. The surface modifications varied for different training technologies.

The SiO_2 glass surface topography measurements with the Atomic Force Microscope (AFM) showed significant differences in the surface parameters after wall cleaning technology. The lamp bulb walls surface after cleaning procedure is much smoother.

The tomography approach was used to obtain the spatial distributions of the emitting atoms. For the tomography, the experimental measurements were made using the digital images of the capillary lamps. We have found non-homogenoeus structure of the argon atom distribution, which could be a cause for wall blackening.

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Reference

[1] H. D. Witzke, in: Proceedings of The 9th International Symposium on the Science and Technology of Light Sources, Ithaca, NewYork, USA, 2001 (Cornell University Press, Ithaca, NY, 2001), pp. 357 – 368.