Spectroscopic study of low temperature atmospheric pressure argon microwave microplasma

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We present results of the spectroscopic investigations of the atmospheric-pressure argon microdischarge. The microplasma in the form of a column was generated with simple coaxial microwave microplasma source (MMS) [1].

The electron density in the microplasma column was determined using the method based on the Stark broadening of H_β spectral line spontaneously emitted by the plasma, using two theories: one presented by Griem, Kolb and Shen in 1962 and second presented by Gigosos and Cardenoso in 1996. The rotational spectra of OH radicals ($A^2\Sigma^+ \rightarrow X^2\Pi$) and N_2 molecules second positive system ($C^3\Pi \rightarrow B^3\Pi$) were observed in microplasma spectrum. The N_2 molecules spectra were observed due to the fact, that microdischarge was placed in ambient air and the OH radicals spectra as well as the H_β spectral line of the hydrogen Balmer series were observed in the emission spectrum due to presence of the water vapour in surrounding air. The measured spectra were compared with simulated in SPECAIR [2] program in order to determine rotational temperatures of OH radicals and N_2 molecules, to estimate the microplasma gas temperature.

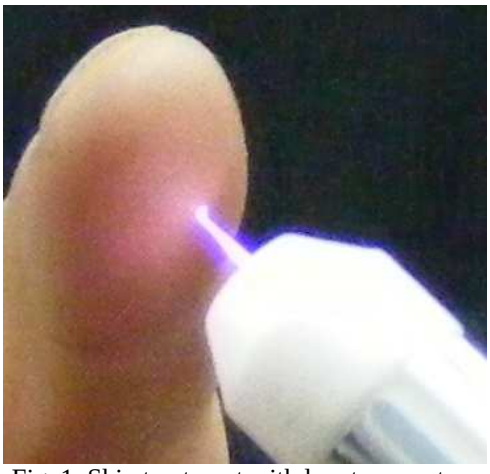

Fig. 1. Skin treatment with low temperature argon microwave microplasma.

All experimental tests were performed with argon flow rate from 1 to 5 l/min and absorbed microwave power from 5 to 50 W. The microplasma occurred in the form of a small plasma column at the top of the MMS (see Fig. 1). The length and diameter of microdischarge ranged from 1.5 - 25 mm and 0.5 - 2 mm, respectively, depending on the discharge conditions.

The measured electron density ranged 10^{14} – 10^{15} cm^{-3}, depending on the discharge conditions and the location within the microplasma column. Determined rotational temperatures were from 700 K for OH radicals and 800 K for N_2 molecules.

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References:

[1] B. Hrycak, M. Jasiński, J. Mizeraczyk, *Spectroscopic investigations of microwave microplasmas in various gases at atmospheric pressure*, DOI: 10.1140/epjd/e2010-00265-6

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