# Advances of contemporary gas-discharge fundamental physics and based on them new microwave plasma sources

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New microwave plasma sources (coaxial microwave plasmatron, microwave arc, " biresonant" plasma source) based on the revealed nonlinear properties of microwave gas discharges are described. Possible fields of their applications in a modern technique (predominantly in plasmachemical technologies) are considered.

Investigations of fundamental problems of microwave gas discharges made it possible to create a new microwave plasma sources designed and suitable for physical laboratory research as well as for some applications.

The following physical phenomena, revealed and investigated in the last decades provided the basis for these plasma sources (microwave plasmatrons):

- Low threshold microwave discharges (sparks) at a metal-dielectric interface [1-3];
- Thermal-ionization instability of self-non-sustained microwave discharge attaining strongly nonlinear phase [4-5];
- "Plasma resonance" phenomenon consist in the totality of nonlinear processes, occurring where the plasma density of nonmagnetized plasma approaches the critical value $n_{ec} = m(\omega^2 + \nu_{eff}^2)/4\pi e^2$ on its essentially nonuniform profile (here, $\nu_{eff}$ is the effective frequency of electron-neutral collisions, $\omega$ is cyclic frequency of microwave radiation) [6].

Three type of microwave gas-discharge plasma sources based on the list phenomena have been elaborated, investigated and applied for some technologies:

- Coaxial microwave plasmatron [7];
- "Microwave Arc" [8] and
- "Biresonant" plasma source [9].

These microwave plasma sources schematically are shown on the Figs. 1-3.

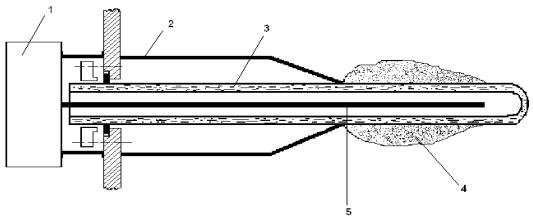


Fig.1. Schematic of coaxial microwave plasmatron 1-magnetron; 2-outer electrode; 3-quartz tube; 4-gas-discharge near-the-surface plasma layer; 5-inner electrode – rod; 6-wall of reactor chamber

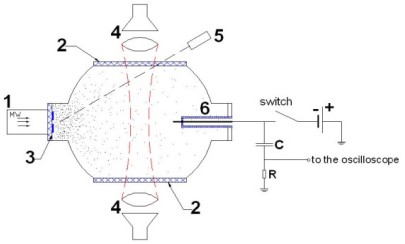


Fig.2. Scheme of experiment with the "biresonant" plasmatron. 1-cylindrical waveguide; 2-quartz window; 3-plasma-forming window; 4-horn-lens antennas of microwave interferometer; 5-plasma of "halo" optical spectrograph; 6-Langmuir probe.

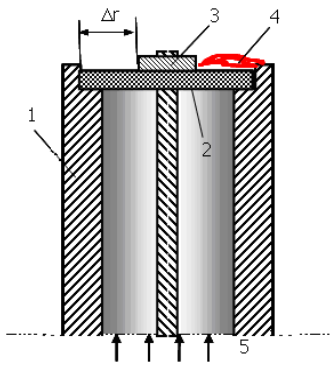


Fig.3. Scheme of "Microwave Arc". 1-outer electrode; 2-quartz disk; 3-inner electrode; 4- discharge channels; 5-microwave radiation.

In experiments for studying the characteristics of plasma generated by these plasmatrons role of the above mentioned fundamental peculiarities of microwave discharges have been revealed. New microwave plasma sources have been applied successfully as a basic part of plasmachemical reactor dedicated to the gas-synthesis production, oil gas utilization, CFCs decomposition, nanocrystalline silicon production.

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