Plasma-liquid system with pulsed discharge for the creation and focusing of acoustic waves

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Plasma chemistry considered plasma as a chemical active medium, which activity is provided by high temperatures and high concentrations of reactive components: ions, electrons, radicals, excited particles, and photons. The price for such high activity of plasma is a low selectivity of plasma-chemical transformations.

Today, the need to increase the selectivity of the plasma chemistry become stronger by the transition of the chemical industry to "green chemistry". "Green Chemistry" is a departure from the traditional concept of evaluating the effectiveness of the chemical yield to the concept that evaluates the cost-effectiveness as the exclusion of hazardous waste and non-toxic and / or hazardous substances.

Perspectives towards green chemistry have processes in supercritical fluids (water, carbon dioxide). Water in supercritical condition unlimited mixes with oxygen, hydrogen and hydrocarbons, facilitating their interaction with each other - oxidation reaction are very fast in scH_2O. For example, in supercritical water significantly increases the rate of oxidation, such as the use of water can be not only effective destruction of hazardous chemical substances, but also hydrolysis, hydration, formation or degradation of carbon-carbon bonds, and so on. These supercritical conditions in liquids can be created in plasma-liquid systems with pulsed discharge. The usage of pulsed electrical discharges in the liquid comes up new related factors: strong ultraviolet emission and acoustic or even shock waves. In addition, acoustic oscillations in such systems can be used as an additional mechanism of action for chemical transformations.

Perhaps the most promising method of using acoustic waves is their generation by axial pulsed electric discharge with followed reflection from a perfect cylindrical surface, which can provide better compression symmetry convergent acoustic waves, as in the gas and the liquid. The study of such approach is devoted this work.

Plasma chemical reactors with cylindrical geometry and discharge plasma axial location created on the condition that the characteristic radius of the plasma channel - r was much smaller than the radius of the cylindrical reactor R was used in work. The cylinder radius was much larger than the cylinder height – H: $R/H = 13{,}5$.

Different parameters of the system: the current and voltage oscillograms and oscillograms of optical emission of discharge was measured. Different working liquids: distillate, ethanol and ethanol/water mixture. Implemented system operation modes with a single pulse, double pulse and series of pulse of different frequencies. The convergent and divergent acoustic waves that formed by discharge were investigated. The velocity of acoustic waves propagation were measured. Were measured the amplitude of acoustic signals from the discharge energy. The heat release in the system depending on the discharge energy was investigated. The radial distribution of the amplitudes of acoustic signal were measured and analysed. The fuel reforming in such a system was investigated.