

CHEMICAL REACTIONS IN PLASMA GENERATED IN THE PRESENCE OF FERROELECTRIC SAMPLES

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ABSTRACT

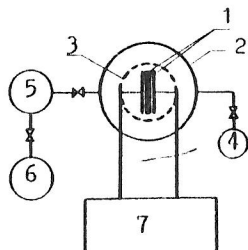
The effect of the plasma formed in the presence of a ferroelectric samples on the behaviour of various chemical substances has been studied. The results of experiments show that it is necessary to carry out a complex analysis since all components of the system are affected by plasma under the experimental conditions.

1. INTRODUCTION

Chemical effects of the electric discharge generated in the presence of ferroelectric samples have not been investigated so far. This type of discharge accompanied by the formation of a thin plasma layer near the surface of a polarized ferroelectric sample was observed to occur during the changes in the domain structure of the ferroelectric sample (1). The energy needed to provoke electric discharges in the fluid surrounding the ferroelectric sample is furnished by strong electric fields appearing at its surface (2). In thus formed plasma various chemical reactions were found to occur (3). The results of preliminary studies of chemical reactions occurring in a plasma generated near the surface of a ferroelectric which have been carried out at our laboratory are presented here.

2. EXPERIMENTAL

All experiments were carried out in a system shown schematically in Fig. 1.



1. discharge area
2. reaction chamber
3. quartz window
4. manometer
5. vacuum system /if needed/
6. substrat source
7. alternating current high - voltage generator

Fig. 1. Scheme of the reaction system.

The most of experiments were carried out in two type of electrode systems Fig.2.

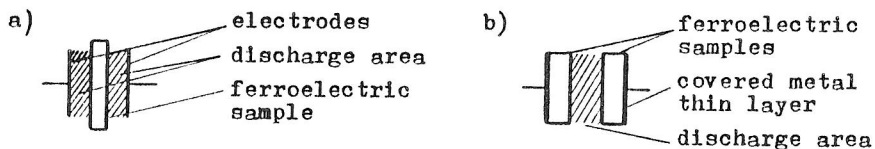


Fig. 2. Types of discharge area.

Experiments with powdered barium titanate were also carried out in the system shown schematically in Fig.3.

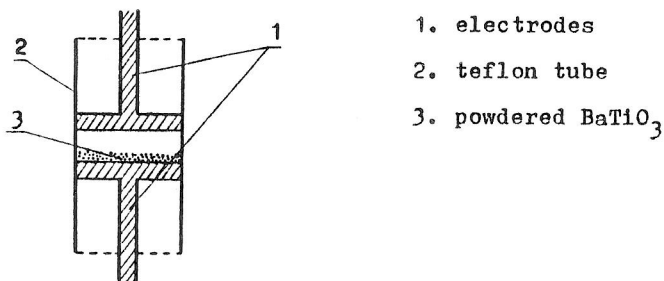


Fig. 3. Scheme of the reaction system using in experiments with powdered BaTiO_3 .

The sample of ferroelectric was polarized by applying an outer electric field /an alternating current of 50 Hz, maximum voltage 2,5 kV/. Seignette's salt, TGS single crystals and barium titanate based ceramics /a polycrystalline form/ as a ferroelectric samples and platinum, silver, gold, copper, tin, zirconium and steel as electrodes were used.

Nitrogen, oxygen, air, methane, benzene and toluene as a substrates were studied. Experiments have been carried out at normal and reduced pressure in the static and flow conditions. Some of intermediate reaction products were determined using an ISP-51 spectrograph.

To identify final reaction products gas chromatography in experiments with methane and classical analysis in experiments with oxygen and air were used.

3. RESULTS

It has been observed in the experiments:

- The most stable discharge have been formed in electrode system shown in Fig 2b.
- The surfaces of electrodes and ferroelectric sample have been covered by a thin layer non identified substances. Schematically it is shown in Fig 4. for experiments with benzene (4)

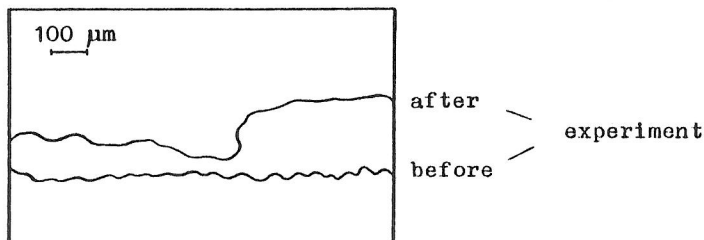


Fig. 4. The surface outline ferroelectric sample /ceramic/ before and after experiment with benzene.

- Gascons reaction products have been formed: ozone in the case of oxygen (5) nitrogen oxides and ozone in the case of air (6), ethane, acetylene, ethylene, propylene, propane and butanes in the case of methane.

- A parallel spectroscopic study performed on the copper or silver-ferroelectric sample - methane system have revealed the presence of molecular bands of the CH and C_2 radicals. The atomic lines of titanium and barium were also determined. It been found (7) that the dependence of threshold voltage on the methane pressure is small, the emission band intensities depend lineary on the discharge current Fig.5.

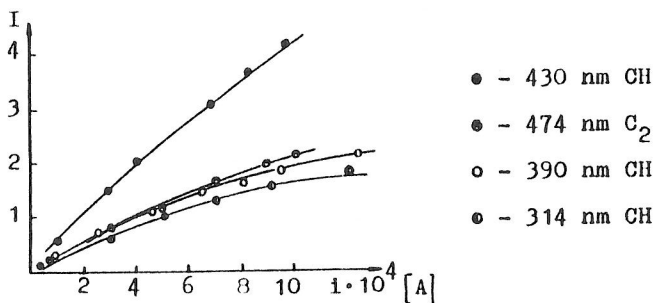


Fig.5. Dependence of relative intensities of the CH and C_2 emission bands on the discharge current.

- The main products reaction of air were ozone or nitrogen oxides. This depends of experimental conditions and may be valid in practice.

- The results of experiments show (8) that it is necessary to carry out a complex analysis since all the components of the system are affected by the plasma under experimental conditions.

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