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ON THE CHARACTERISTICS OF X-RAYS EMITTED FROM THE PLASMA FOCUS DEVICE

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Abstract: On the plasma focus device we investigated the X-ray emission of different gases: H,D,N and the mixture H+Ar(25%Ar, 75%H). For the detection of X-ray roentgenographic method was employed with use of Al absorbers of different thickness. Only the soft X-rays (up to E=18 KeV) were detected.

1. INTRODUCTION

For diagnostics of plasma focus (PF) good knowledge of emitted X-rays is of exceptional importance, both its energy spectrum and exact lateral position of the emission source. By some results we can see (Katsumi 1995) that PF "hot spots" from which X-ray emission occurs, coincide with these where the neutrons are emitted.

2. EXPERIMENTAL METHOD

The plasma focus we used is of the Mather type (Mather 1965) and consists of two brass coaxial electrodes (the outer electrode consists of 18 cylindrically positioned brass roads) separated by a glass insulator sleeve at one end, where the breakdown of a gas discharge takes place.
The dimensions of PF chamber are chosen for its optimized operation at an energy up to 40kJ and a charging voltage up to 40 kV. Pressure

inside the chamber varied between 1-10 mbar. Development and acceleration of the plasma focus current sheet have been measured by means of the fiber optic cables that are "looking" at certain points inside the chamber.

Electrical circuit parameters are chosen in such a way that the radial compression starts near the current maximum. For the X-ray detection we used the roentgenographic method. In order to determine the maximum energy of emitted X-rays, we used Al absorbers of different thickness.

Roentgenographic films were protected from the influence of visible light emitted in PF, placed on the windows inside the PF chamber with a thin Al foil (20 μm).

In this work, knowing the space above the electrode from which X-rays are emitted, we simplified the method of detection which is seen from Fig.1. The lateral resolution of detected X-radiation in front of the film colimators (2 cm long; ϕ1 mm) is placed (in form of stainless steel disk) which was described in the previous work. Film and colimator are positioned so that they could observe the space around the top of central electrode. Distance between colimator and central electrode is 130 mm. Aluminium absorbers of different thickness (maxim. 1000 μm) were used for analysis of emitted X-radiation.

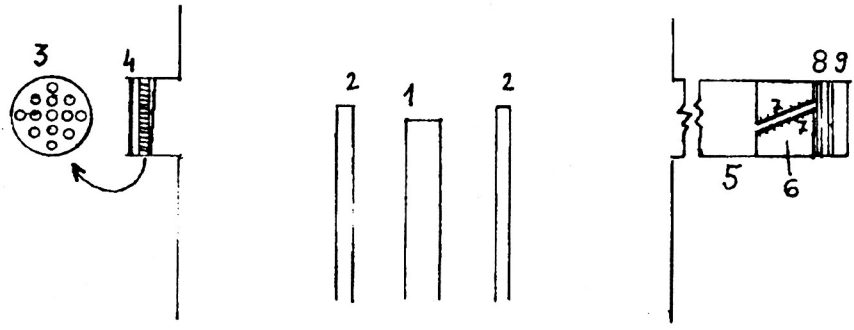

Fig.1. Cross-section of PF chamber 1-central electrode, 2-outer electrode, 3-stainless steel disk, with Al absorbers, 4-X-ray film. 5-tube (up to 2 m long) 6-beam devider, 7-mica sheets, 8-Al absorber, 9-X-ray film

On disk in front of the film there are 13 holes covered with Al of different thickness (50-1500 μm). Energy of X-radiation is calculated on the basis of absorber thickness used.

In the experiment with pure D or in the mixture Ar+H we confirmed an important fact that the X-rays emission, in both cases occurs in a narrow zone around the central electrode, this zone is greater than that corresponding to "hot spot" from D-D reaction products, including the neutrons emitted (Antanasijević at all, 1997).

3. RESULTS

Blackness obtained on the X-ray films after passing through the MICA sheets (8 on Fig.1), shows that in the X-ray spectra emitted from PF, λ corresponding to MICA latice constant exists.

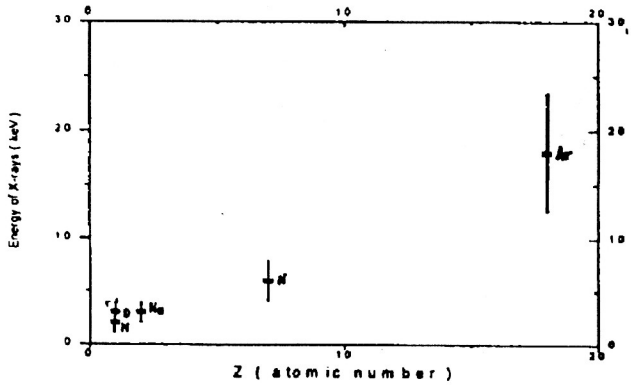

Fig.2. Dependence of energy X-ray on gas atomic number

In Fig.2 we show dependence of energy of emitted X-rays on the gas atomic number Z. For the X-rays emission of mixture Ar+H we obtain larger energy value in comparison with the previous results (Antanasijević 1995), but at the same time concentration of Ar in this experiment was much larger. Estimated error in this experiment is around ±30%.

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