impurity analysis from the energy spectra of Penning electrons in plasma using a wall probe

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In [1] was patented ionization detector for gas analysis by plasma electron spectroscopy (PES), which allows working at high gas pressures. It is based on the measurement of the electron spectra of reactions Penning ionization of atoms and molecules of the impurity A by metastable buffer gas atoms B \*, as is advisable to choose a helium that can ionize any impurity in the gas

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| --- | --- |
|   | (1) |

Here the appearance energy of fast electrons in the reaction (1) is *Ep = Em – Ei*  *(Em = 19.8 эВ*, *Ei* - excitation energy of metastable helium and impurity ionization, respectively). To implement the method [1-2] is necessary to EDF fast electrons was nonlocal, and slow electrons temperature was low, in steady-state conditions is realized in the negative glow plasma [3]. In this case the  is narrow peaks corresponding to the energies *Ep* of their appearance in the reactions (1) [1,2]. The condition of nonlocality the EDF is  ( – energy relaxation length of the electron,  – the characteristic size of the plasma region) corresponds to the condition , i.e., at high (atmospheric) pressure  the size is. In this case, enter in plasma volume classic probe to measure the distribution function is not technically possible. This difficulty in [1, 2] it was proposed to overcome by using a wall probe for registration the EDF fast electrons.

In this paper, updated expressions presented earlier in [4] for the relation between the impurity concentration and the measured current density of Penning electrons. It is shown that for a plane-parallel geometry with gap *L* bounding the plasma volume, the electronic spectrum of the reaction (1)  is related to the second derivative  of the potential scanning  follows

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|  | (2) |

where – is a constant process (1), and  and  – there are a concentration of metastable helium and impurities, respectively.

Thus, it is shown that the second current derivative of Penning electrons produced by reaction (1) in negative glow plasma on the wall probe can determine the type of the impurity and its concentration.

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References

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