Electrode geometry effects on x-ray emission, plasma inductance, voltage, and current derivative signals obtained from a plasma focus device

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Abstract:

Recently, the plasma focus (PF) device has been used as pulsed radiation (x-rays and neutrons) source to irradiate the cancer cells *in vitro* [1-3]. It is shown that the cancer cells respond to the pulsed x-ray irradiation (emitted from the PF devices) is not the same as in the case of the conventional continuous x-ray irradiation. Keeping in mind such application of pulsed x-ray, in the present work, a kilojoule plasma focus device, namely PF-2kJ (a hybrid-type, close to the Mather-type), is operated at various pressures of hydrogen gas with five cylindrical anodes of the same lengths but different in shapes to study the x-ray emission in each case. The electrical signals of Rogowski coil (current derivative at the cathode), voltage divider (voltage at the anode), and photomultiplier tubes signals (X-rays) were analyzed at every pressure for all the anodes. Inductance and the voltage at the time of the pinch were derived from the measured voltage and current derivative signals. X-rays dose measurements were performed using thermoluminescent dosimeters (TLD-100). For a Mather type PF device, it was reported that it performs better with cathode bars [4]. In the case of the PF-2kJ, it is observed that including cathode bars reduces the pinch repeatability, therefore, has poor performance.

1. J. Jain, J. Moreno, R. Andaur, R. Armisen, D. Morales, K. Marcelain, G. Avaria, B. Bora, S. Davis, C. Pavez, and L. Soto, AIP ADVANCES 7, 085121 (2017).
2. J. Jain, 2017, 'Studies on plasma focus devices and characterization of pulsed neutron and x-ray emission for cancer cell irradiation', Ph.D. Thesis, University of Talca, Talca, Chile.
3. F. Buontempo, E. Orsini, I. Zironi, L. Isolan, A. Cappellini, S. Rapino, A. Tartari, D. Mostacci, G. Cucchi, A. M. Martelli, M. Sumini, G. Castellani, PLoS ONE 13(9) (2018).
4. D. Piriaei, S. Javadi, T. D. Mahabadi, H. R. Yousefi, A. Salar Elahi, and M. Ghoranneviss Physics of Plasmas 24, 043404 (2017).