Interaction of D and He Plasmas with Tungsten in Fuego-Nuevo II

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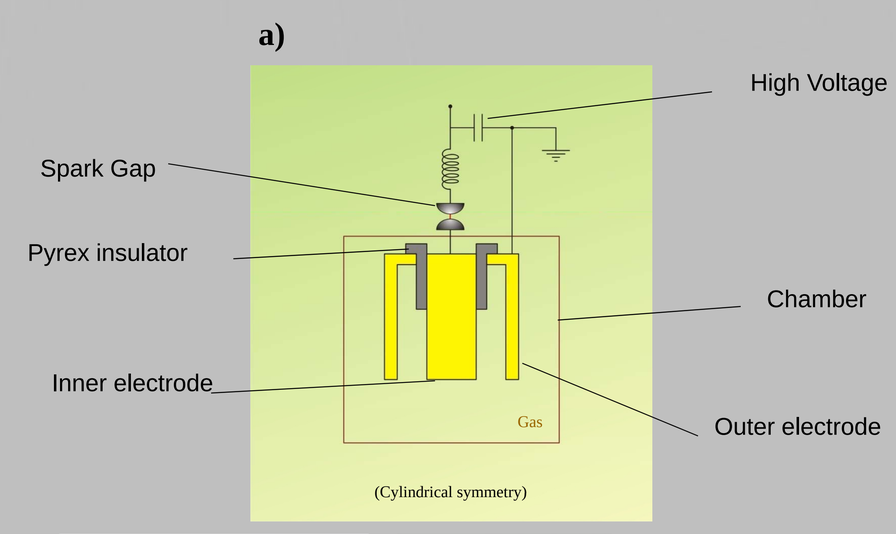
Abstract

Tungsten is one of the main candidate materials for plasma-facing components in a future fusion power plant. The experience with tungsten as plasma facing material is less than with graphite, and a need for a comprehensive database has been identified [1]. Many studies simulate the plasma wall interaction using ion beams [2], while only a few use plasma simulators [3,4]. Recently the question of the interaction of neutrons added to the interaction of mainly helium plasmas with tungsten is gaining relevance [5].The Fuego-Nuevo II [6] is a plasma focus device which can produce dense magnetized helium and deuterium plasmas. Additionally it produces a significant amount of high energetic neutrons during deuterium operation. In this paper we present preliminary results of tungsten targets exposed to deuterium and helium plasmas in the Fuego Nuevo II device

Introduction

Fuego Nuevo II is a Mather-type Plasma Focus device with 4.8 kJ of stored energy. Fig 1) shows a schematic diagram of the “gun”, together with details for anode and cathode. Fig 2) shows the evolution of the plasma inside of the gun, starting with he discharge from left to right until it pinches at the end. Figure 3) shows the typical Rogowski coil and scintillator signals of a shot with deuterium



Cathode:
12 brass bars over a 10 cm inner diameter circum-ference

Anode:
OFHC copper,

Figure1) a) Schematic Diagram of the “gun” and electric wiring. b) The anode is made of a OFHC copper cylinder, while the cathode is made out of 12 OFHC copper bars. [1]

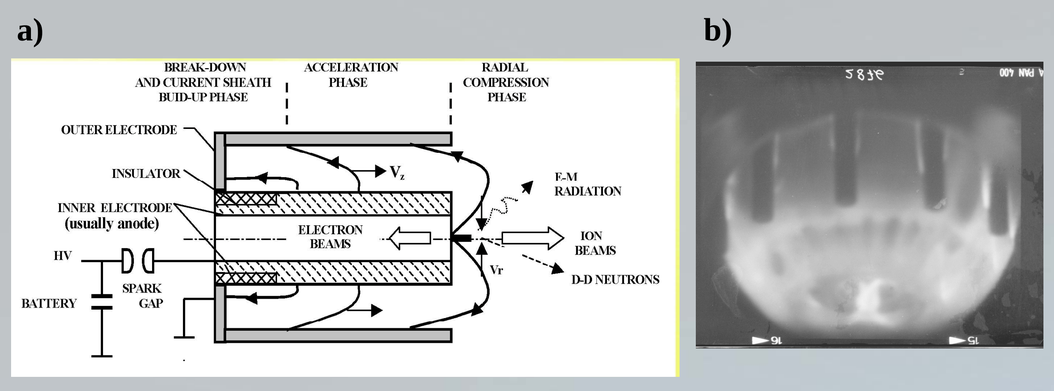


Figure 2) a) Evolution of the plasma inside of the gun and b) plasma picture at pinch.

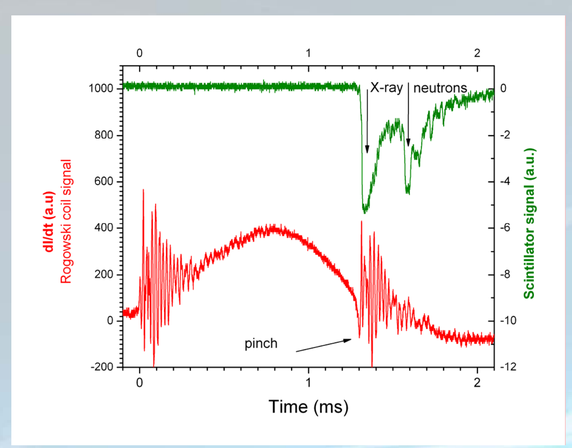


Figure 3) Typical Rogowski coil and scintillator signals for a deuterium discharge

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Tungsten Experiments

Thin foils 0.1 mm thick [7] were used as supplied. The samples were positioned at 10 cm from the “gun”; additional copper and Ti control samples were positioned at the bottom plate to register for impurities.

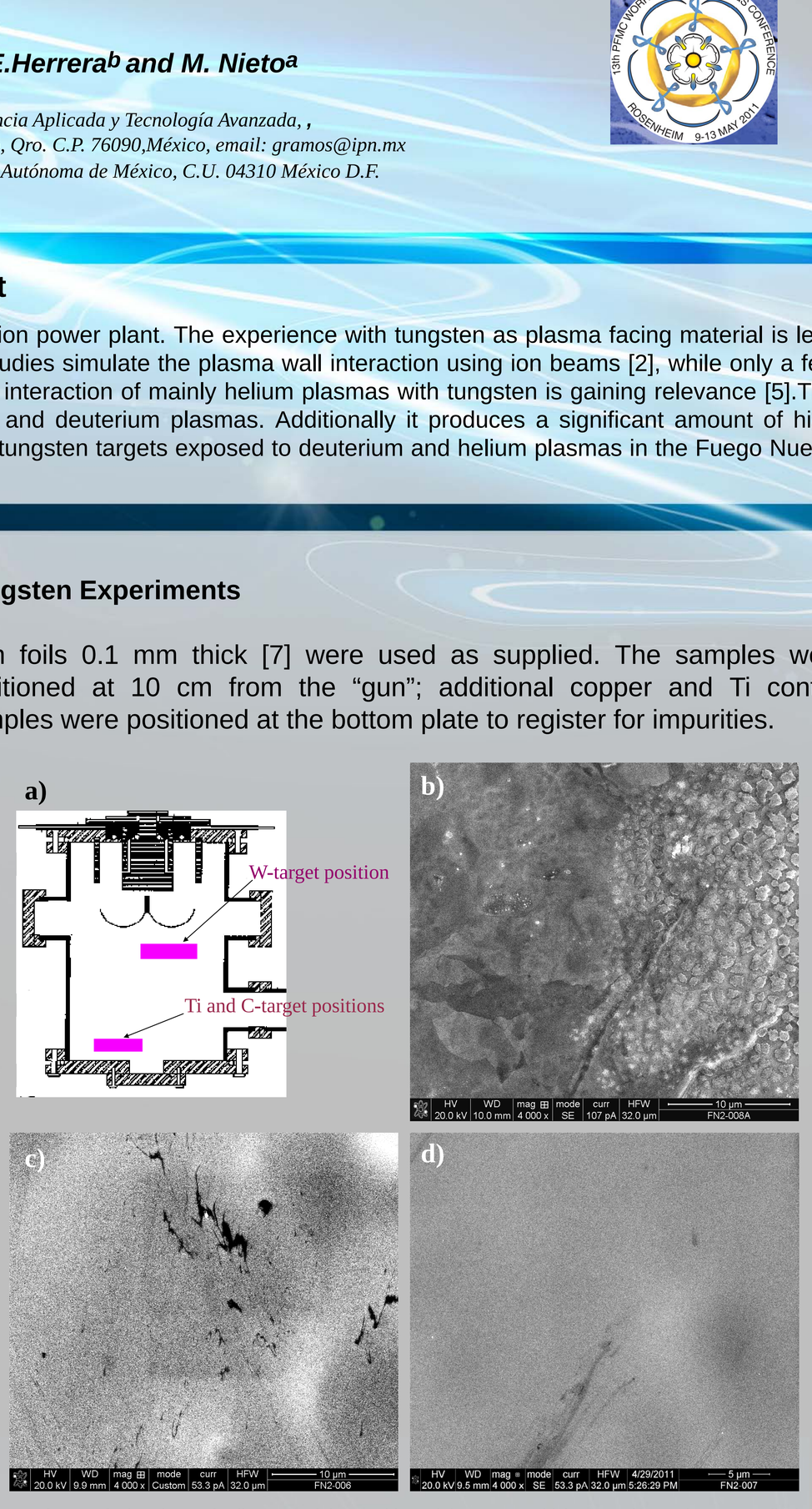

Figure 4) a) Schematic diagram of the position of the targets. b) image of sample as supplied c) Sample after 25 shots with deuterium d) sample after 30 shots with He.

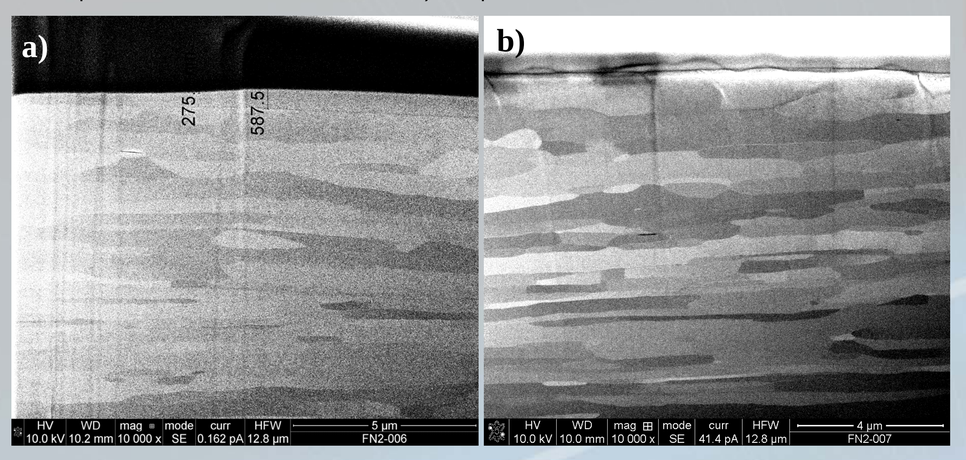

Figure 5) Cross-section images at 10000X of W-samples a) after 25 shots with deuterium b) 30 shots with He

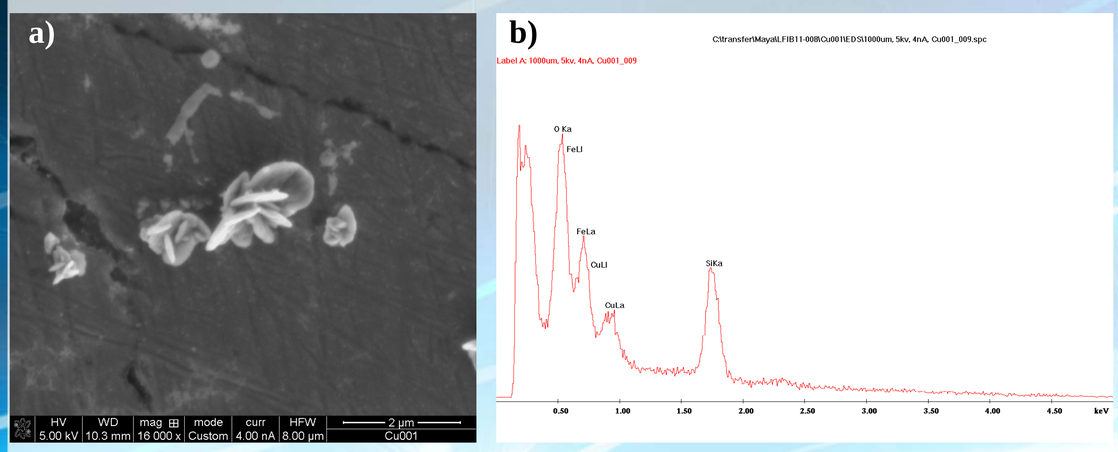

Figure 6) a) Impurities observed on Cu-target b) EDS spectrum corresponding to impurity.

References

[1] M. Kaufmann, R. Neu, Fusion Engineering and Design 82, 521(2007)
[2] A. Debelle, et.al, Nuclear Instruments and Methods in Physics Research B 268, 223 (2010)
[3] M.J. Baldwin, R.P. Doerner, Journal of Nuclear Materials 404, 165 (2010)
[4] M.J. Baldwin et al., Journal of Nuclear Materials (2010) (in press)
[5] Q. Xu , N. Yoshida, T. Yoshiie, Journal of Nuclear Materials 367–370, 806 (2007)
[6] F. Castillo, et al., Plasma Phys. Control. Fusion 45, 289 (2003)
[7] Goodfellow Cambridge Ltd, Huntington U.K., Tungsten LS369668