Contents

Chapter 1

Temperature profile

Power deposition from plasma to target, different contributes.

Black body radiation emission and grey body emissivity.

Detector functioning.

The detector is an uncooled microbolometer VOx, formed by an array of pixels as in figure **??**. Incident radiation strikes a material that has it's absorption peak in infrared wavelenght, produced heat changes electrical resistance of the circuit and the resulting current intensity circulating in it is measured and associated to collected radiation intensity.

1.0.1 Experimental setup

Estimation of plasma power deposited on a target is done measuring how much temperature rises durgin the application of plasma on a known target, with known heat capacity. The use of a thermocamera allows to study target's temperature profile in its entirety, visualizing also heat conduction on target's borders.

Camera We utilize a termographic camera *FLIR A655sc* ([1]) with a spectral range of $7.5 - 14\,\mu\text{m}$, resolution 640×480 and detector pitch $17\,\mu\text{m}$, equipped with a lens with focal $41.3\,\text{mm}$ (field of view 15°). Temperature evolution is a phenomenon with charateristic time of several seconds, considering it, frame rate acquisition is set at $2\,\text{Hz}$.

The temperature scale that converts intensity of the radiation in temperature is done by *FLIR* software, setting the appropriate emissivity.

Source We use the latest source model, B in chapter **??**, at different pulse repetition frequencies f and voltage peak values V_p. Plasma deposition it's not a continuos phenomenon, it happens in correspondance of voltage pulse and has a charateristic duration of $1\,\mu\text{s}$ at maximum, see chapter **??**. Given a time interval, f defines the number of pulses that arrives in that interval and the effective discharge time.

The gas used to produce plasma is helium, set at a flow of $2\,\text{L/min}$.

Target The target used it's an aluminium disk with radius of 7 mm and an height of 1 mm, on a plastic support with a width of 5 mm.

Target is positioned at a distance of 210 mm from camera lens. At those conditions, once the image is on focus, pixels have a dimension of 86.4 µm.

To study how distance between target and source influences energy deposition, target is positioned at a distance of 5.5, 7.5 or 9.5 mm from the end of the source head.

Measurements procedure Ultimately measurements are done with different voltage pulse repetition frequencies f, voltage peak values V_p and distances between target and source d. Once those parameters are set, the measurements starts and we follow an approximative timeline:

- acquisition of at least 4 frames for background evaluation in 2 s
- start of gas flow for a minimum of 5 s
- start of the discharge for a minimum of 30 s
- stop of the discharge and acquisition with only gas flow for 5 s
- stop of gas flow

1.0.2 Temperature profile

Every frame gives information on the temperature of every pixel of acquired image at a given time, as in figure **??**.

From the images taken with the source activated, it's possible to find the center of the target as the point with maximum temperature and select a square window intersting for temperature evaluation centered on it. We consider a square window of 22 mm where it's possible to see the entirety of the target and the support material around it.

We are intersted to temperature difference in the discharge phase of measurements, to find it we evaluate background temperature for every pixel.For every pixel we take the average value acquired before gas opening and subtract it to pixel value in other frames.

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1.0.3 Power deposition

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