Tipo di tesi: Laurea Magistrale

Corso di Laurea: Fisica, Ingegneria

Tipologia: teorica - numerica

Titolo della tesi: Modelling of fast response surface thermocouples for fusion plasma facing components

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Relatore Accademico: prof. Piergiorgio Sonato

Capogruppo: Mauro Dalla Palma

Argomento della tesi: Thermal measurements are performed on plasma facing components of fusion machines, especially on the divertor to provide coolant calorimetry (coolant temperatures measured at inlet and outlet [[i]]), local temperatures relevant to the component surface (sensors embedded in the component under the exposed surface [[ii]]), bulk calorimetry (time variation of temperature observed at the same sensor [[iii]]), or the power density deposited in each castellated module (temperatures detected at the same time by sensors located at different distances from the heated surface [[iv], [v]]). Signals of these temperature measurements will be used during pulse operation or first wall conditioning for parameters monitoring, protection, and control.
Surface eroding thermocouples (or “self-renewing thermocouples”) can be used to instrument plasma facing components in which the thermojunction is formed in a very thin layer at the surface of the sensor [[vi]]. This construction leads to a fast thermal time response (10 ms), robust design, and is particularly useful to characterize the surface temperature evolution of the plasma facing component with the carrier body made of the same material as the component. Surface thermocouples also enable a simple computation of the power density applied to the component. Arrays of surface thermocouples proved to be a vital component of the overall diagnostic set and can be installed to measure pulsed heat flux in the divertor of tokamak [[vi]].
The activity will consist of modelling the signal response of surface eroding thermocouples, developing a sensor design, and integrating the concept in the castellations of the DTT device divertor [[vii], [viii]].

Data della proposta: 22 maggio 2019

Stato: non assegnata

Laureando/a: -

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[ii] M. Dalla Palma et al, The thermal measurement system for the SPIDER beam source, Fus Eng Des, vol 86, number 6-8, pp 1328-1331, 2011

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[iv] M. Rodig, Comparison of electron beam test facilities for testing of high heat flux components, Fusion Engineering and Design 51–52 (2000) 715–722

[v] M. Dalla Palma et al, Simulation of the beamline thermal measurements to derive particle beam parameters in the ITER neutral beam test facility, Rev Sci Instrum, vol. 89(10), pp 10J111 1-5, 2018

[vi] J. Ren, D. Donovan, J. Watkins, H. Q. Wang, D. Rudakov, C. Murphy, A. McLean, C. Lasnier, E. Unterberg,
D. Thomas, and R. Boivin, The surface eroding thermocouple for fast heat flux measurement in DIII-D, Review of Scientific Instruments 89, 10J122 (2018); doi: 10.1063/1.5038677

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[viii] DTT, Divertor Tokamak Test facility, Interim Design Report, https://www.dtt-project.enea.it/downloads/DTT_IDR_2019_WEB.pdf