**CVD Diamond Tomography for the DTT Fusion Device**

F. Bombarda1, S. Palomba2, S. Cesaroni1, C. Verona2, G. Verona-Rinati2, M. Marinelli2, M. Angelone1, M. Iafrati1

*1 ENEA, Fusion and Nuclear Safety Department, Frascati (Rome), Italy*

*2 “Tor Vergata” University of Rome, Industrial Engineering Department, Rome, Italy*

The DTT tokamak [1] presently under construction at Frascati (Rome, Italy) is a relatively large device of major radius *R*= 2.19 m, minor radius *a*= 0.70 m, toroidal field on axis *BT*= 6 T, plasma current *Ip*= 5.5 MA. Even if designed to operate with Deuterium fuel, the neutron and gamma radiation flux will pose very substantial challenges for any diagnostic system required to operate in the proximity of, or inside the vacuum vessel, as in the case of typical Si diodes used for Soft-X-ray Tomography.

For this reason, the use of a different kind of UV-SX photon detectors diodes is addressed and investigated, namely the single crystal, Chemical Vapor Deposition (CVD) diamond detectors being produced at the laboratory of Industrial Engineering Department of the University of “Tor Vergata” in Rome. These have been successfully tested on JET [2] and FTU [3], but never in full tomographic layout (in fact only two detectors were installed on each machine), and their locations so removed from the torus that both radiation and heat were not a concern.

The CVD diamonds exhibit a number of attractive features: they are sensitive to radiation from 5.5 eV up to tens of keV but are visible blind and much more radiation resistant than silicon, especially the thin samples suitable for photon detection. They can also operate at room temperature with very high S/N ratios, are very small in size and, most importantly, they can be placed in the machine high vacuum, without need for Be windows. Furthermore, considering the geometry of DTT port ducts, the coverage of the plasma poloidal section required for a proper tomographic inversion is allowed only by placing the diodes very close to the plasma itself. Consequently, the suitability of Si or CdTe diodes is not obvious and requires a careful assessment.

The main features of the CVD diamond tomography systems proposed for DTT are presented, with the results of the simulations used to guide the design of the optical layout and the various detector configurations adopted for different applications. The main technical issues associated with the mounting of a large number of diodes in close proximity to the plasma, insulation, cabling, heat and radiation loads, and front-end electronics will be discussed.

[1] R. Ambrosino et al, *Fus. Eng. & Des.***167** (2021) 112330

[2] M. Angelone *et al.,* *Nucl. Instrum. Methods* A **623** (2010) 726

[3] F. Bombarda *et al*., *Nucl. Fusion* **61** (2021) 116004