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Tritiated Dust: their impact on tokamak operation

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During the ITER operation, plasma interacts with the machine plasma facing components (PFCs) through various physical processes and gives birth to particles from nanometer to tens of micron sizes that are called dusts in the fusion community. Depending on the plasma wall interaction, different types of dust will be created from almost spherical particles induced by high heat flux interaction with metal (unipolar arcs, ELMs, disruption) to fractal ones created by accretion in the edge of this high density/long pulse plasma machine. The dust properties especially their ability to be covered by an oxide insulating layer and their surface topology deeply affect their tritium inventory. As instance, it has been already shown [El Kharbachi- 2014] that dust tritium inventory is two to three orders of magnitude higher than massive material. It can be then asserted that tritium inventory can be ranged from some GBq/g for tungsten particles to much higher values for beryllium ones. Due to tritium beta decay, these particles are rapidly positively charged. As an example, a 5 µm diameter single tungsten particle with a tritium inventory of 10 GBq/g will have a charge of 6.10 17 Coulomb in 1 hour. Dust physico-chemical properties and radioactive electrical self-charging process have numerous consequences in term of operation and safety and the major goal of this \ presentation is to highlight them.

The first step of this paper consists to list how the dusts are created in the ITER machine using laboratory and tokamak current results. The properties of the created particles (composition, size and morphology) considering all the physical processes initiated in this framework will be presented. Moreover, we will insist here on the fact that all the particles are covered by an insulating oxide layer that triggers dust adhesion properties as it has been clearly exemplified in [Peillon-2017]. In this paper, experimental investigations on the electric field strength required to overcome the adhesion forces of micron size tungsten metallic dust as well as silver and aluminum oxide in powdery form deposited on a conductive surface are presented.

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