Spectral and Radial Distributions of Runaway Electrons in a Disruption at TEXTOR

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In tokamak disruptions runaway electrons with energies up to several tens of MeV are produced. These electrons present a severe threat for the integrity of a large fusion device as ITER and beyond. A new heat load probe is designed to intentionally encounter damage from a runaway beam which is created during the current quench phase of a disruption in TEXTOR. The objective is the analysis of the damage which occurs during one single discharge. The probe is mounted on a fast insertion mechanism which enables inserting the probe into the plasma just prior to the programmed disruption. The latter is induced by injecting argon from a fast valve. This way of reliably generating runaways is well established at TEXTOR. The detecting part of the probe consists of an epoxy resin in which copper particles have been embedded. This part of the probe is protected against the thermal plasma by a 5 mm thick graphite housing. Only runaway electrons with energies beyond 4 MeV can propagate through the graphite mantle and deposit their energy in the copper which has a high electron stopping power. The copper particles get heated and hence the surrounding resin locally melts and evaporates. The runaway damage in the probe material is analyzed using metallographic and thermogravimetric methods. The impact of the runaway beam onto the probe is simulated using a 3D Geant4 Monte Carlo code. The comparison of the experimental results with the simulations provides the energy spectrum and the radial decay distribution of the runaway beam. The findings are in good agreement with the assumption of an exponential radial decay and energy spectrum of the runaways.

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