CVD Diamond Windows for Electron Cyclotron Resonant Heating in Fusion

Dirk Strauss[1], Gaetano Aiello[1], Andreas Meier[1], Sabine Schreck[1] and Theo Scherer[1]
[1] *Karlsruhe Institute of Technology, IAM, Postfach 3640, 76021 Karlsruhe, Germany*
dirk.strauss@kit.edu

Electron cyclotron resonant heating (ECRH) in nuclear fusion combines the injection of multi megawatt power with the possibility to focus the millimeter wave beam to small spot sizes of few centimeters. The ECRH allows efficient plasma heating as well as localized current drive for magneto-hydrodynamic stabilization of e.g. neoclassical tearing modes that create local magnetic islands with a fast loss of plasma confinement. One of the key challenges for high power ECRH systems is the provision of suitable confinement windows.

The low loss tangent, high thermal conductivity and outstanding mechanical properties qualify diamond as the state of the art material for high power millimeter wave heating system windows in nuclear fusion devices. Artificial diamond disks are grown by CVD in diameters up to 180mm, sufficient for the usual waveguide diameters and window designs.

The principles of ECRH systems will be presented with a focus on the permittivity of diamond, which determines the loss tangent/cooling requirements and suitable disk thicknesses for reflection suppression. Further concepts and status for fixed frequency and broadband windows for f=100-240GHz and beam powers up to 2MW will be discussed.