The double-disk diamond window as backup broadband window solution for the DEMO Electron Cyclotron System

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Motivation

- The second variant of the DEMO Electron Cyclotron System (ECS) requires gyrotrons frequency steering
- Broadband optical chemical vapor deposition (CVD) diamond windows are thus required
- Primary choice is the Brewster-angle window. The double-disk window is the broadband backup solution

Approach

- Symmetry condition
- T dependent properties
- 10 l/min at 20°C at inlet
- 0 Pa at outlet
- 2 MW @ 204 GHz Gaussian beam
- 20 mm beam radius
- \( P_{\text{abs}} = 1847 \text{ W in disk} \) (\( \tan\delta = 3.5\times10^{-5} \))
- Reference case and sensitivity studies

Results

- Max T of 238°C at disk center (250°C limit)
- Max stress in the disk below the 150 MPa conservative limit
- Max stress in the cuffs below the minimum ultimate tensile strength (177 MPa)

- The flow rate of 10 l/min is the minimum boundary condition
- The beam radius of 20 mm is the upper boundary limit (window aperture radius of 40 mm)
- The \( \tan\delta \) value of 3.5E-05 is reasonable to account for disk degradation potential factors

Objectives

- Investigate the possibility of using the double-disk window for the DEMO beam scenarios by CFD and structural analyses
- Perform sensitivity studies with respect to mass flow rate, loss tangent, beam radius and frequency
- Explore conceptual design alternatives to increase safety margins against limits

Symmetry condition

T dependent properties

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