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Overview of Tetrode-Based RF System for High-Power Plasma Heating Operation in the 4-9 MHz Range for the MPEX Project at ORNL

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The MPEX (Material Plasma Exposure Experiment) project at ORNL requires a high-power RF system to operate in the challenging frequency range of 4-9 MHz, essential for sustaining plasma needed in material testing. A tetrode-based RF system has been chosen for this application due to its superior performance in generating high power RF across these frequencies. Unlike solid-state RF systems, which face significant challenges in combining to a power level of 500kW within this frequency range, tetrode-based systems excel due to their inherent ability to handle large power loads. The tetrode's vacuum tube technology allows for greater tolerance to impedance mismatches and load variations, which are common in plasma environments. Additionally, tube-based systems can deliver the necessary high peak and average power without the thermal management complexities that solid-state systems encounter at similar power levels. The robustness, reliability, and long operational life of tube-based RF systems make them not only still competitive but sometimes the only viable technical solution for demanding applications like MPEX, where consistent high power across a broad frequency range is critical. These advantages ensure that tube-based RF technology remains a cornerstone in high-power RF applications.

Author: FRITSCHE, Bodo

Presenter: FRITSCHE, Bodo

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