Modeling of high-density magnetically enhanced inductive plasmas generated by symmetrical solenoid coils

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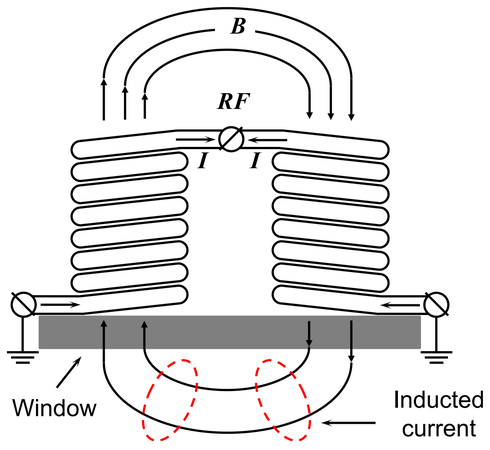
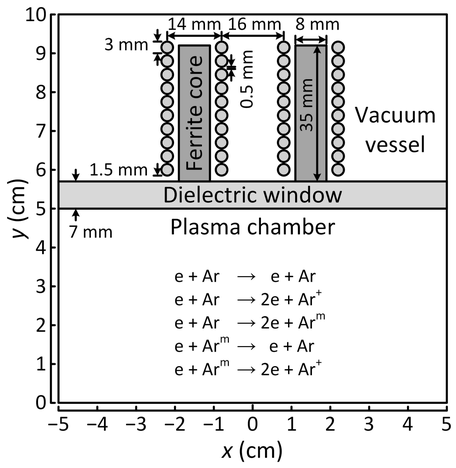
Introduction

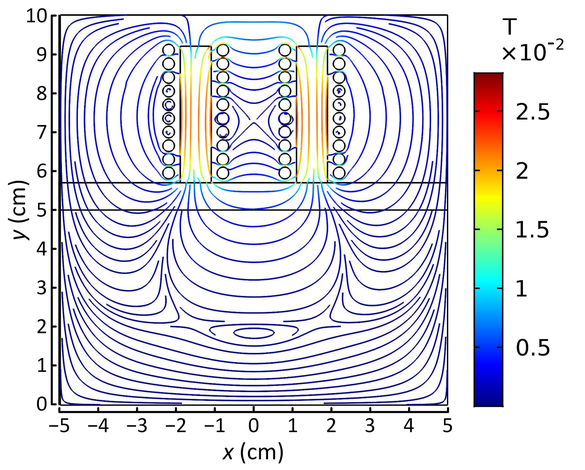
A magnetically enhanced inductive plasma source (MEIPS) was proposed to address the limitations of conventional inductively coupled plasma (ICP) sources. The MEIPS combined two solenoid induction coils wound in opposite directions and the grounded ends were positioned on the dielectric window. The **capacitive coupling** between the plasma and the coils was subsequently **minimized**. The induction coils created a **confined magnetic field** within the plasma region. By adding ferrite cores and lowering the RF frequency, a significant increase in the energy-coupling efficiency can be achieved.



Schematic diagram of the magnetically enhanced inductive plasma source (MEIPS)

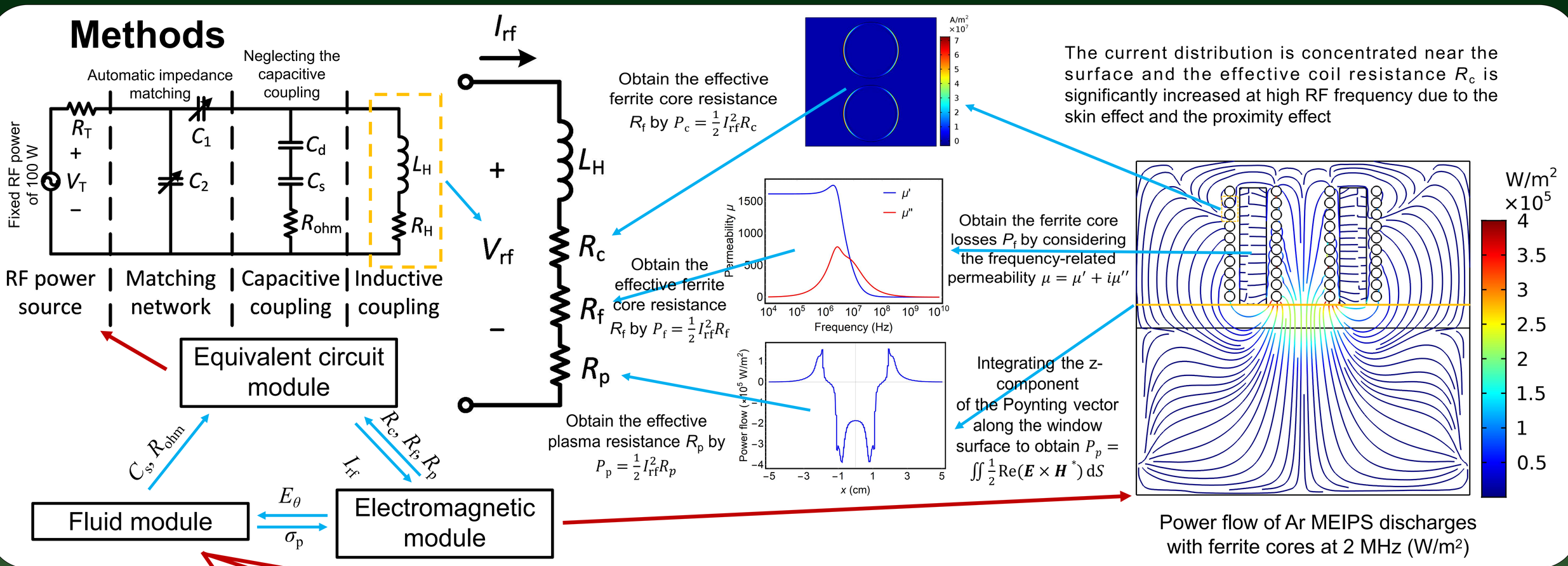


Schematic diagram of the simulation region of MEIPS

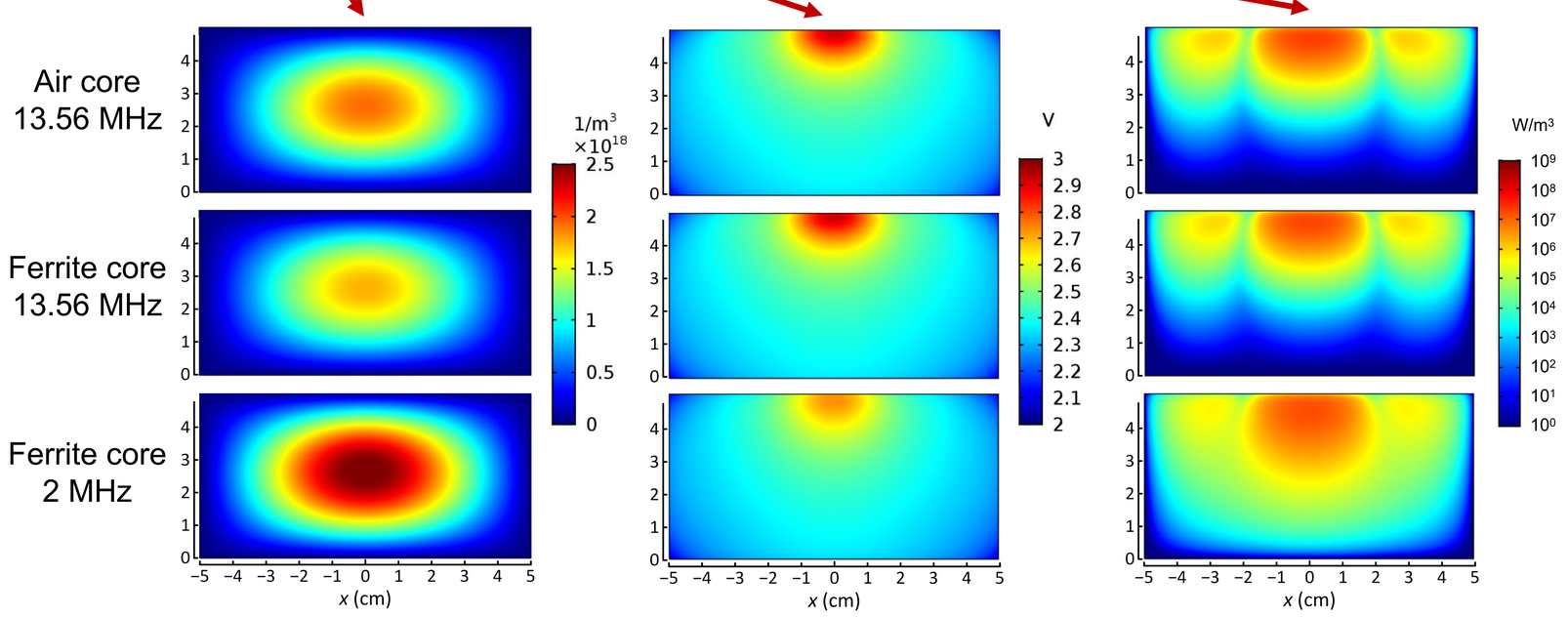


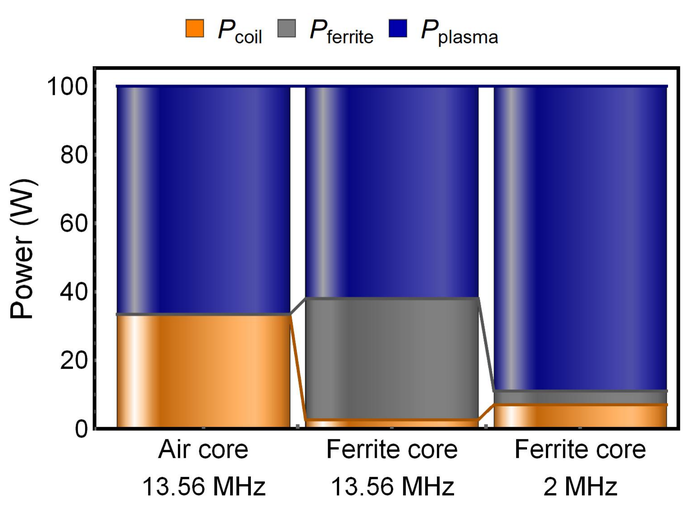
Magnetic field ***B*** of Ar MEIPS discharges with ferrite cores at 2 MHz (T)

Methods



Results





Power fractions at different parameters (W)

Conclusions

- A magnetically enhanced inductive plasma source generated by symmetrical solenoid coils was proposed and simulated;
- A confined magnetic field within the plasma region was displayed;
- The RF current required to sustain the plasma was significantly reduced by adding the ferrite cores, however, the saved coil losses due to the smaller current were offset by the introduced ferrite core losses;
- An increased energy-coupling efficiency is achieved by decreasing the RF frequency, resulting in an enhanced ICP discharge with higher electron density.

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WHERE DISCOVERIES BEGIN

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