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SIMULATION OF RF POWER MATCHING UNIT FOR APLICATION IN CLEANING RF DISCHARGE IN ITER VACUUM VESSEL *)

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An effective and controlled power delivery the RF discharge used for cleaning ITER in-vessel mirrors from contamination by sputtering products of the first wall is achieved by matching the impedances of the RF source, supply line and load circuit. The impedance of the load circuit is determined by the RF discharge itself as well as by the reactive elements inevitably introduced by the design of the first mirror assembly [1]. To reduce the absorption of active RF power in a long supply line, it was previously suggested [2] to place an L-shaped (Fig. 1a) quadripole RF matching device (MD) in the immediate vicinity of the first mirror.

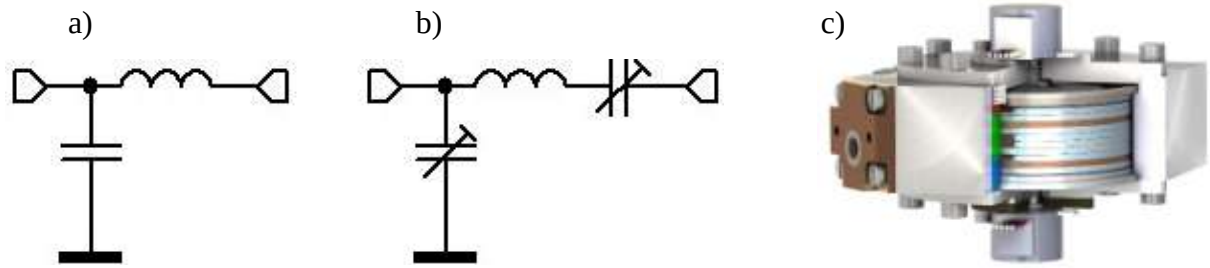

Figure 1. RF pre-matching device for application in ITER: a) non-tunable L-shaped circuit; b) circuit with trimming capacitors, c) design overview

Experiments with a non-adjustable MD revealed a number of disadvantages related to the fact that optimal adjustment point depends on the discharge operating point parameters such as pressure and sort of gas, frequency and supplied RF power, while the achievability of its position is limited by the manufacturing and assembling accuracies of MD parts. Fine-tuning such an MD is extremely labor-intensive, since it requires venting the discharge chamber and disassembling the MD housing. In this case, the adjustment occurs without direct control of the result.

The listed difficulties can be overcome by introducing tuning elements into the circuit (Fig. 1b). Implementing this kind of design is seriously complicated by the limited choice of materials suitable for ITER in-vessel application caused by harsh operating conditions.

The developed design of an adjustable MD (Fig. 1c) comprises a stack of metal foils separated by dielectric layers. Some metal foils are movable and serve as the plates of two trimming capacitors. RF analysis and optimization of this 3D structure were carried out using full-wave finite element simulations.

References

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*) abstracts of this report in Russian