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P1.3009 Determination of electron density in microwave plasma torch by microwave interferometry

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The microwave plasma torch represents a class of plasma generators, important for their applications. In cases, where ethanol (typical carbon structures growth precursor) is admixed to the working gas, the environment becomes dusty, which brings known problems with plasma diagnostics (e.g. electron density cannot be determined from Stark broadening of H). This contribution presents the numerically enhanced microwave interferometry for electron density measurement in such discharges, with the plasma electron density and experimentally observed phase shifts connected via the complex plasma permittivity [1].
The 2.45 GHz atmospheric pressure plasma torch enclosed in quasi-cylindrical reactor chamber (150 mm i.d., 400 mm height) is sustained in argon atmosphere with varying
admixtures of ethanol and molecular gas (O2, H2). For diagnostics, the Mach-Zehnder configuration of 34.5 GHz interferometer (with its probing arm extending inside the reactor chamber) is used, as depicted in Fig. 1. This setting of the interferometer is noteworthy for the absence of the discharge tube walls combined with close proximity to the discharge. Despite this, the small dimension of plasma channel dictates the use of numerical model (COMSOL Multiphysics). Typical results for varying discharge power are shown in Fig. 2.

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References
[1] Heald M A, Wharton C B, Plasma diagnostics with microwaves, Wiley, 1965

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