Energy Balance Investigation of an Inductively Coupled Plasma Torch for Plasma Figuring

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Abstract

The next generation of metre scale optical surfaces require advanced sub-aperture figuring apparatus. Due to limitations of numerically controlled polishing, numerous optical surfaces will be figure corrected at nanometre level using energy beams. This Plasma Figuring process employs an inductively coupled plasma torch that is run at atmospheric pressure. The process is scrutinised in this paper from an energy dissipation viewpoint.

Temperature measurement in the strong electromegnatic field of plasma torch was carried out. Instrumented sensors and shielding preparation were made for the data log as shown in Figure 1 (left). During the experiments, the radio-frequency (RF) power was increased from 300 W to 1000 W. The temperature difference results for each RF power steps are displayed in Figure 1 (right). Thus power dissipated from coolant -coil + nozzle- could be estimated to 585.W when plasma torch is powered at 1.2 kW. This energy dissipation rate is 48.75% of the input power. Results show energy dissipation levels into the plasma torch, substrate and critical cooling elements. Results enable to improve the deterministic function when applying dwell time figuring technique.

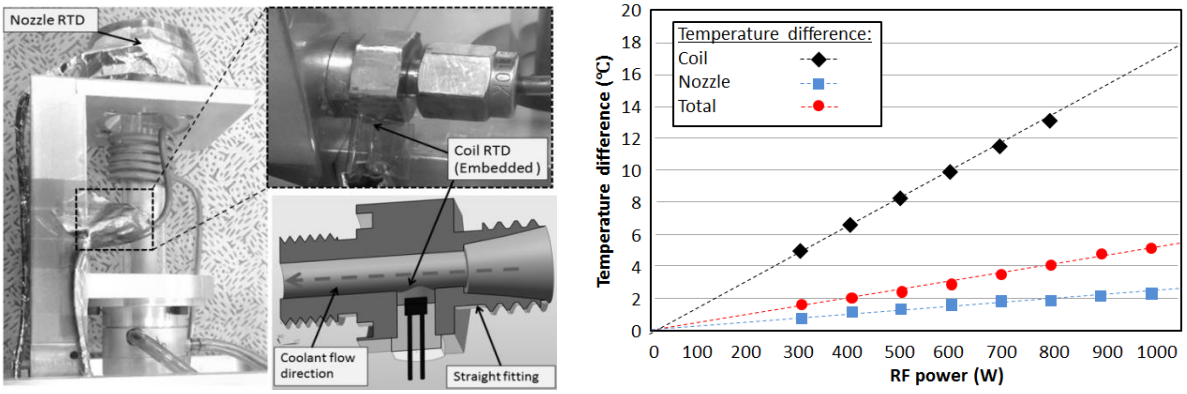

Figure 1: Instrumented plasma torch using RTD sensors (Left) and RF powers versus temperature differences for three coolant channels (Right).