

AN INVESTIGATION OF DBD UNDERWATER JET PLASMA PROPERTIES AND ITS INTERACTION WITH LIQUID AND SOLID SUBSTRATES

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Underwater plasma discharges hold great potential for water treatment and chemical processing in liquid systems in general. Such discharges however typically involve small interelectrode spacings or rely on surface diffusion from the gas phase into the liquid. Both situations limit their applicability to high throughput, in-volume water treatment applications. The DBD plasma jet currently under investigation generates a plasma jet within an injected gas stream while submerged, thereby allowing for in-volume water treatment.^{1,2} The emission spectra and associated continuum radiation emitted by the jet was analyzed while operating the jet on argon to determine electron number density and electron temperature. Coupled with heavy particle temperatures inferred from rotational spectra, a comparison could be made between the electron and gas temperatures to ascertain whether or not the plasma jet is non-equilibrium. The interaction of the jet with aluminum substrate resulted in significant modification to the substrate surface, suggesting jet-driven chemistry. Results from TEM and SEM analysis of the substrate are also presented. Before the emergence of the jet, the source operates in an intense internal, microdischarge mode. An open question is does the upstream plasma products diffuse out of the source, affecting reactivity of the water in the absence of the jet? A comparison between the affect of the plasma source operating in a purely DBD mode and in the jet mode on a methylene blue dye-water solution was made to address this question.

1. J.E. Foster et al, "Underwater operation of DBD plasma jet", Plasma Sources, Science and Technology, online publication April, 2010.
2. J.E. Foster et al "Characterization of DBD Plasma Jet", 62nd Annual Gaseous Electronics Conference, Vol. 54, No. 12 Oct. 20-23, 2009.