PLASMA DIAGNOSTICS OF UNDERWATER ELECTRICAL DIAPHRAGM DISCHARGE FOR FABRICS TRETMENT

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Abstract. Underwater pulse diaphragm discharge is an effective tool in the production of hydrated electrons and hydroxyl radicals, which can be used for material surface modification (bondability, hydrophilicity, surface energy). For efficient material treatment it is necessary to identify operational key parameters controlling the discharge plasma characteristics and to establish some appropriate diagnostic methods and models for plasma characterization.

The plasma parameters - electron number density, temperature of electrons, excitation temperature, have been measured by optical emission spectroscopy completed by the voltage, and current measurement. The sampling optical fiber was installed directly in the slit to minimize the water absorption of light emission. The electron number density will be estimated preferable from spectral line profile of H_α. Our contribution will summarize the results of our experiments.

1. INTRODUCTION

Plasma treatment of textiles is becoming more and more popular as a surface modification technique. Plasma treatment changes the outermost layer of a material without interfering with the bulk properties. Textiles are several millimetres thick and need to be treated homogeneously throughout the entire thickness. It is known that hydroxyl radicals generated in low-pressure H_2O plasma may be used to incorporate hydroxyl functionality onto a polymer surface to increase their surface energy and reactivity. Underwater pulse diaphragm discharge is an effective tool in the production of hydrated electrons and hydroxyl radicals, which can be used for material surface modification (bondability, hydrophilicity, surface energy).

Material applications of polymers have become increasingly specialized relying on specific combination of properties. In particular, applications in adhesion and coatings require specific surface properties such as bondability, hydrophilicity, and surface energy. However, common polymers very often do not posses the surface properties needed for these applications. Thus, surface modifications are used to transform these inexpensive materials into valuable finished products.

Preliminary results on physical characteristics of pulsed underwater diaphragm electrical discharge [1, 2] have shown that the discharges burning in tap water, water-chelaton solutions, and some other water-based solutions can be used as a potential atmospheric-pressure H_2O - plasma source for surface activation of various materials in the form of fabrics, films, fibers, etc. The discharge burning at atmospheric pressure can substitute low-pressure plasma sources [3, 4, 5, 6] when atmospheric pressure on-line surface treatments of polymer products with the low added value in large amounts are required.

Underwater pulsed corona discharges generated in liquid water matrix at atmospheric pressure have been demonstrated to be effective in the production of hydrated electrons and hydroxyl radicals [7, 8, 9, 10, 11, 13, 14]. Following the pioneering work of Clements et al. [7] on pulsed streamer corona generated using point-to-plane geometry of electrodes in water, various types of underwater electrical discharges producing hydrated electrons and hydroxyl radicals in liquid water-based media have been tested for the removal of low levels of non biodegradable organic pollutants from ground water and industrial waste

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