Atmospheric-pressure microwave Ar/N_2 afterglow for heat-sensitive surface treatment

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Fig 1. Discharge and afterglow.

Microwave discharges stand out due to their operational flexibility in terms of pressure and gas composition for surface treatment and functionalization. Besides, these plasmas allow for the remote treatment of surfaces in the flowing afterglow which contains active species resulting from reactions of long-lived (metastables) species [1], with few or no charged particles, while gas temperature notably decreases, thus being especially suitable for the treatment of thermosensitive materials. The use of this postdischarge has been shown to be effective for the activation of aluminum surfaces [2] and the N-doping of graphene [3].

In this research, an atmospheric-pressure surface wave discharge working at 200 W was assessed for the treatment of polyethylene surfaces. A N_2 flow of 25 mL/min was introduced into an Ar (4.9 L/min) plasma. Under these conditions, a diffuse orange afterflow or postdischarge appears after the discharge (Fig.1). In this region, optical emission spectroscopy revealed the emission of radiation in both orange-infrared and UV spectral ranges due to the first positive nitrogen system and NO γ-,β- systems. Oxidated polyethylene surfaces were treated in the afterglow region at 2.5 cm right after the end of the discharge. X-ray photoelectron spectroscopy analysis showed the incorporation of N atoms and a higher oxidation of the surfaces without any thermal surface damage. These results suggest the potential of microwave afterglow for the modification of heat-sensitive surfaces such as polymers or biological materials such as seeds.

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