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Online Deposition of Thin Film on Wires by Atmopheric Pressure Dielectric Barrier Discharge

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Atmospheric pressure plasmas are more and more interesting regarding to industrial applications, as no vacuum system is required. Dielectric barrier discharges are especially said to be convenient in the treatment of materials at the industrial scale, notably because of the possible scale up of the process to treat online important areas of flat materials.
But one of the main advantages of theses discharges is the ability to tune the reactor geometry to fit with the substrate shape. We present here results related to the treatment of cylindrical materials.
We developed a process that allowed to perform thin film deposition on metallic wires by using an atmospheric pressure dielectric barrier discharge in argon, with a coaxial geometry. Octamethyl cyclotetrasiloxane molecule was used to deposit organosilicon thin films, while carbon-based layers were deposited by using myrcene diluted in ethanol. Deposition rate, chemical surface composition and thin film morphology were studied depending on precursor flow rate, dissipated power in the discharge and deposition time. Homogenous polymer coatings were successfully deposited at the surface of the wires, with deposition rates up to 2,000 nm per minute.
This high deposition rate was shown to be suitable for industrial application. Then, we performed an upscale of the process to deposit a 100 nm thick layer on a 200m long wire in less than 10 minutes. This was achieved by installing several reactors in series. The increase of the process was shown to be possible by increasing the number of reactors.
Also, a preliminary treatment (cleaning, activating and/or oxidizing) was also possible in a single-step process, thanks to the addition of a reactor before the reactors used for the deposition process, in which argon was mixed with molecular oxygen gas flow.

Keywords
AP-DBD
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polymer coating