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Development and study of a plasma source dedicated to the atmospheric pressure spatial atomic layer deposition

Atmospheric pressure non-thermal plasma is widely used for various nanoscale material fabrication techniques [1], which are becoming increasingly critical for optoelectronics materials and devices, such as composite transparent conductive electrodes and all-oxide solar cells [2]. In particular, plasma has been demonstrated to assist the atmospheric pressure spatial atomic layer deposition (AP-SALD) processes by providing expected reactive species to improve the thin film, lower the deposition temperature and expand the range of materials that can be deposited [3].

In this communication, we first designed and developed an atmospheric pressure plasma reactor which maybe can be coupled to an AP-SALD head [4]. The plasma was generated using sur-face dielectric barrier discharge (SDBD) which was placed in a 3D-printed resin box. Such a reactor was powered by a homemade, compact, high-voltage pulse power supply, which deliv-ers high power to create a plasma with sufficiently high energy density to ensure enough active species, to assist the thin film deposition, such as atomic oxygen [4], ozone [5] and atomic ni-trogen. An electrical investigation of the whole system was conducted, and the power dissipated by the reactor was proportional to the applied HV pulse amplitude. A spectroscopic study to identify the active species produced by the plasma proved the existence of oxygen atom and dinitrogen ion, and the oxygen atom increased with the applied HV pulse amplitude.

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Affiliation de l'auteur principal

GREMI

Auteur principal: Mlle TIAN, Tian (GREMI)

Co-auteurs: M. NDIFFO YEMELI, Gervais Blondel (GREMI); Dr RABAT, Hervé (GREMI); Dr MUÑOZ-ROJAS, David (LMGP); Dr AUBRY, Olivier (GREMI); M. CHARLES, Gilles (GREMI); M. LEMAIRE, Julien (GREMI); Prof. HONG, Dunpin (GREMI)

Orateur: Mlle TIAN, Tian (GREMI)

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