**STUDY**

Measurements with electric probes belong to the oldest and most often used procedures for diagnosing low-temperature plasma. The method was developed by Langmuir and his team in the 1920s.

Probes offer a number of advantages compared with other diagnostic methods:

- The technical complexity of the probe method implementation is comparatively small, and the experimental set-up is comparatively simple.
- From the probe data it is possible to determine quite a large variety of quantities characterising the plasma under study, e.g., \( n_e(r^+, t) \), \( n_i(r^-, t) \), \( T_e(r^-, t) \), \( f_e(w^-, r^-, t) \), \( \phi(r^-, t) \), \( E^- (r^-, t) \).
- The probe method enables the performance of time- as well as space-resolved measurements of the above-mentioned parameters.

**METHOD**

This paper presents selected recent results on the application of Langmuir probes to diagnose plasma jet systems. To demonstrate the versatility of the Langmuir probe method the authors provide examples of measurements of the spatial distribution of the plasma parameters as well as their temporal dependence in cases when the plasma jet system operates in a pulsed regime.

In addition, Langmuir probe measurements of low-pressure and atmospheric-pressure plasma jet systems that are currently used for experiments with deposition of materials with special properties are also presented.
FINDINGS AND CONCLUSIONS:

Both low-pressure and atmospheric-pressure plasma jet systems are at present used for deposition of materials with attractive properties (ferroelectrics, TCOs, materials for aviation industry, etc) on different substrates including those of plastics. When necessary, the pulsed method of operation can be applied, and this method has a number of advantages:

- control of the heat load onto the substrate;
- control of the ion/neutral flux to the substrate;
- limitation of the substrate ion bombardment; reduction of the compressive stress in the film;
- control of the dissociation of the precursor; reduction of the precursor fragmentation.

The study shows that over a wide range of plasma parameters the Langmuir probe method gives valuable information on plasmas. It is also comparatively easy to set up the Langmuir probe diagnostic and to make routine measurements.

However, many of the theories often used for interpreting the probe data have been gathered using the assumption of a Maxwellian EEDF and of the absence of collisions of charged particles in the probe sheath. For instance, in the low-pressure plasma jet generated by an RF or dc hollow cathode discharge, the customary collisionless probe diagnostics can be used to determine the plasma parameters. The effect of collisions might already be important at pressures around tens of Pa for ions and around hundreds of Pa for electrons. When the measured EEDF cannot be approximated by a Maxwellian function, it is still possible to measure the electron density and the mean electron energy from integral formulae using the experimentally measured EEDF.

REFERENCES