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A robust method for in-situ gas monitoring of CVD processes using optical emission spectroscopy of a pulsed remote plasma

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Effective and robust monitoring of individual gas concentrations during CVD processes offer a unique insight into the condition of the process. In particular, CVD processes that utilize large organic molecules as precursors, such as Atomic Layer Deposition (ALD), can present challenges due to contamination of sensors and subsequent stability issues.
Conventional quadrupole residual gas analysers have difficulty monitoring CVD processes due to the high process pressures and the presence of contaminating hydrocarbons contained within many CVD precursors. For these reasons, monitoring of precursor gas concentrations during the CVD process is not often undertaken.
An alternative gas sensing technique, built around the principle of remote plasma emission monitoring, can operate directly at pressures up to 1 mbar. This technique involves the generation of a small, remote plasma using an inverted magnetron placed within the vacuum system. Importantly, this plasma, generated inside the sensor, has a sole function as an optical emission spectroscopy (OES) based gas detector and does not affect the process itself. This work will demonstrate that the sensing method is robust when exposed to two examples of CVD process; ALD and HMDSO based SiOx CVD. Previous work has demonstrated the usefulness of this technique with PVD processes. However, contamination and instability developed in the plasma generator when exposed to large organic precursors. This work will describe a novel method of generating the detector plasma using a high peak power, low duty cycle pulsed voltage. The results show that the pulsed power technique is effective in preventing contamination of the sensor’s electrodes as well as improving the detection sensitivity of common ALD precursors and their reaction by-products through increased molecular disassociation. Also, a method of regenerating the condition of the sensor electrodes using a pulsed oxygen purge and an MF plasma will be discussed and demonstrated with monitoring HMDSO for SiOx process.

Keywords
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