

Characterisation of a He/HMDSO/O₂ microplasma jet by molecular beam mass spectrometry

D. Ellerweg, R. Reuter, K. Rügner, T. de los Arcos, A. von Keudell, J. Benedikt
Research Department Plasmas with Complex Interactions, Ruhr-University Bochum, Germany

A microscale atmospheric pressure plasma jet with parallel-plate rf-driven electrodes at 1mm separation is used to deposit thin organic SiO_xC_y and anorganic SiO_x films on silicon substrates. This is done by admixing a small amount (<0.01%) of hexamethyldisiloxane (HMDSO) or HMDSO/O₂ to the He flow (5 slm) of the microplasma jet.

However, the HMDSO plasma chemistry at atmospheric pressure is due to difficulties in microplasma diagnostics not well-understood. Therefore a molecular beam mass spectrometer (MBMS) is used to get an insight into the HMDSO and HMDSO/O₂ plasma chemistry, respectively.

An HMDSO depletion up to 6% can be measured without O₂ addition and several stable reaction products are identified. This condition leads to organic films.

The resulting film quality improves when O₂ is added to the He/HMDSO flow. The MBMS measurements revealed that thereby the HMDSO depletion increases up to 13% and the densities of the main reaction products increase significantly, too. Additionally, polymerisation products larger than HMDSO appear.

The influence of the admixed O₂ on the HMDSO plasma chemistry has been analysed in detail during a variation of the O₂ flow.

With this knowledge a simple reaction model explaining the measurements was made up.

These MBMS measurements help to understand the HMDSO plasma chemistry at atmospheric pressure and can help to determine the reaction mechanism leading to anorganic SiO₂ film growth. With this knowledge the deposition process of thin SiO₂ films at atmospheric pressure can be optimized.