Plasma polymer film deposition using a magnetically enhanced RF plasma source

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The majority of plasma polymerization processes operate at pressures higher than 1Pa. At these pressures in most cases obtained deposits do not show effects coming from the directionality of the deposition. One way of enhancing the directional effects is to decrease the working gas pressure in order to increase the mean free path of reactive species.

The plasma polymerization source used in this work was designed to study the plasma polymerization process at pressures below 0.1Pa while keeping certain directionality of the depositing flux of plasma polymer precursors. The source consists of the classical RF (13.56MHz, capacitively coupled) tubular reactor enhanced by an external magnetic circuit. The buffer gas (argon) and the monomer (n-hexane) are introduced into the discharge by a capillary. This forms relatively localized zone of higher pressure where the monomer is activated. Due to the magnetic field, the plasma is constricted near the axis of the reactor. With the nearly collisionless gas flow outside the capillary these conditions introduce significant directionality into the plasma polymer deposition. This arrangement may resemble a low pressure plasma jet.

The composition of the films was studied mainly by spectroscopic ellipsometry, XPS and FTIR. The film morphology was examined also by AFM and SEM. The plasma parameters were obtained by the double Langmuir probe.

The deposition rate of the film was relatively slow (several nanometers per minute). Under typical discharge conditions hard C:H plasma polymers were formed. This is consistent with the detected presence of relatively strong (10³V.m⁻¹) electric fields in the plasma. However, at some conditions, softer layers were also prepared. Various directional effects of the deposition were observed. The obtained results are discussed.

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Keywords
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