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Plasma Source for UV Assisted Atomic Layer Deposition of Metal Oxides on Polymer Substrates

Tommi Kääriäinen¹, Marja-Leena Kääriäinen¹, David Cameron¹

¹Lappeenranta University of Technology, Mikkeli, Finland

tommi.kaariainen@lut.fi

In plasma-assisted atomic layer deposition (PA-ALD) plasma energy is pulsed on at an appropriate point during the cyclic deposition process. Plasma assistance is used to generate active radicals for the process and to achieve the low substrate temperature suitable for polymer substrates. Low deposition temperature is important for industrial application areas for ALD, such as diffusion barriers in printed electronics and packaging. The plasma assistance may also result in unwanted effects such as polymer photodegradation and reduced film properties due to a presence of vacuum ultraviolet photons and ions. In this work the rf plasma source has been converted into a photon energy source where the photon energy level can be controlled with an appropriate source design and the wavelengths that are detrimental can be filtered out. This is done by using optical windows with different cut off wavelengths to separate the plasma from the substrate chamber. The window materials were selected having the cut off wavelengths between 170 to 400 nm. Plasma generated UV assisted ALD of the metal oxide film growth showed similar characteristics to typical plasma assisted ALD at low deposition temperature. The effect of plasma characteristics, which determine the photon energy, on the molecular oxygen gas dissociation to produce radicals, on polymer substrate changes and on the film growth characteristics will be further discussed.

Keywords

Plasma assisted atomic layer deposition

polymers

TiO₂

Al₂O₃