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Correlation of plasma parameters with the properties of layers deposited in a multi frequency CCP

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Since 2010 the Institute for Electrical Engineering and Plasma Technology at the Ruhr-University Bochum has been investigating a large-area, capacitively coupled multi frequency plasma source (MFCCP) for deposition of ceramic layers.
The main research objective is to understand the coherences between the plasma parameters and the properties of the deposited ceramic layers.
In particular the influence of the ion energies and the ion-to-neutral flux ratio onto stress, structure, morphology of the aluminium nitride layer is considered. Therefor the advantage of the MFCCP to decouple the ion energy from the ion flux onto the electrodes via electrical asymmetry effect is used to apply a constant ion-to-neutral flux ratio to the substrate, while the influence of the varied ion energies measured with a retarding field analyzer (RFA) onto the layer is studied by different coating analytics.
In addition to understand the plasma-growing layer interaction, monitoring of the deposition process, especially reactive sputter deposition, is important, because plasma conditions (particle fluxes, target coverage, deposition rate, etc.) can change over a deposition time of several hours. In regard to this topic the effect of two different monitoring systems to control the deposition process for aluminium oxide layers were studied:
On the one hand reactive gas flow (partial pressure of the reactive gas) was adjusted to keep the intensity of a spectral line of the sputtered target material constant (constant sputter rate). On the other hand the deposition process was controlled by using a multi resonance probe measuring the electron density. In this case the reactive gas flow was adjusted to keep the electron density (particle fluxes to the electrodes) constant. The consequences for the layer properties are finally presented and correlated with RFA measurements.
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Keywords
layer properties
ion energy
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