The Multipole Resonance Probe: A powerful sensor for plasma process monitoring and control

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The plasma diagnostic tool Multipole Resonance Probe (MRP) has recently been introduced for the measurement of the plasma density. It bases on active plasma resonance spectroscopy and measures the resonance behavior of the electrons. A lot of work was done in the field of modeling, simulations and experiments.
Based on this, the MRP is used as a sensor for real-time monitoring and control of plasma processes. This work presents a feedback control for the plasma density in a reactive rf magnetron sputter process. This process is used for deposition of thin film coatings, in this work aluminum oxide. During reactive sputtering, the control influences deposition rate, film properties and surface conditions, e.g. the secondary electron emission coefficient. Those secondary electrons have a substantial influence on the total plasma density, measured by the MRP in the volume. The MRP and its behavior during the experiment as well as the model-based controller are presented. Experiments show an ambiguous and multivalued dependency of the electron density on the oxygen gas flow. The static and dynamic process behavior are investigated. The model approach is a data-based identification from the experimental results.