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Controlling plasma properties of reactive HIPIMS process using novel combined control technique

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While reactive HIPIMS processes are more and more adapted in industrial plasma applications, the need for reliable and stable control techniques becomes more important for effective production. In HIPIMS plasmas the degree of ionization is one main factor for layer density while layer stoichiometry is ruled by the plasma composition of metal and reactive gas species. Changing either parameter will affect also the other parameter. Thus, controlling both degree of ionization as well as stoichiometry simultaneously can only be realized by combining different measuring and controlling methods.
In standard reactive sputtering processes the plasma stoichiometry is determined by the reactive gas flow and spectroscopic plasma monitoring of emission lines of metals and reactive gas is commonly used to monitor and control the composition of plasma species. This works well for applications where the degree of ionization plays a minor role, however, at higher ion densities the emission lines are affected considerably by the degree ionization which is the case in HIPIMS plasma. A deconvolution of the impact of these effect to the emission lines is quite complex by using only spectroscopic plasma monitoring technique. Thus, a second measurement method is required to provide an additional indicator for the parameters.
By combining the measurement of peak current and peak voltage with the spectroscopic plasma monitoring technique and implementing a common evaluation and control algorithm, a reliable and stable process control of both plasma parameter can be realized in HIPIMS applications.
Examples of Al_2O_3 and TiO_2 applications showing the novel combined control technique are presented and discussed.

Keywords
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