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Concept of calorimetric measurements determining the energy flux onto high voltage pulsed substrate during HiPIMS deposition

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Coating deposition by magnetron sputtering is a common method for various applications including e.g. surface enhancement in optical technologies, scratch and wear resistance, anti-finger print layers, photocatalytic coatings as well as the utilization in photovoltaics and semiconductor industry.
High Power Impulse Magnetron Sputtering (HiPIMS) is a comparatively new technology and its application potential is quite high. It is distinguished from conventional sputtering methods by a significant higher ionization rate of target ions [1]. That allows a defined adjustment of coating structures and offers a high surface homogeneity even for complex shaped substrates. This deposition method reveals lower thermal stress on coated surfaces compared to e.g. DC magnetron sputtering [2].
Innovative combination of HiPIMS and plasma based ion implantation (PBII), the second method used for doping surfaces, offers new possibilities for homogeneous surface modification taking advantage of the high density of target ions and high ionization rate. This technology enables coating and doping of surfaces successively or even simultaneously.
We present recent results on measuring the energy flux onto substrates pulsed with high voltages up to several kV during HiPIMS based Cu deposition. The measurements have been performed by a calorimetric probe [3] analyzing the time dependent change in probe temperature. Due to the use of thermocouples the probe surface could not be biased directly by several kV. Therefore, a grid was installed in front of the probe which was driven by high voltage pulses. Several effects, e.g. the time delay between bias pulse and HiPIMS pulse, have been investigated revealing a parameter setup by which a maximum ion and energy flux towards the substrate can be obtained.
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Keywords
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