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**On the Plasma Parameters in the High Power Impulse Magnetron Sputtering Discharge (HiPIMS)**

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The development of ionized physical vapor deposition (IPVD) was mainly driven by the formation of metal and nitride thin films into deep, narrow trenches and vias that are essential in modern microelectronics. More recently, the control of the ion energy and direction of the deposition species has proved to be an important physical tool in the growth process of new materials and new structures. Over the past few years, various ionized sputtering techniques have appeared that show a high degree of ionization of the sputtered atoms, in the range 50 – 90% [1]. This is often achieved by the application of a secondary discharge to a magnetron sputtering discharge, either inductively coupled plasma source (ICP-MS) or a microwave amplified magnetron sputtering. High power impulse magnetron sputtering (HiPIMS) is a more recent sputtering technique that utilizes ionized physical vapor deposition (IPVD) [2]. High density plasma is created by applying a high power pulses to a conventional planar magnetron sputtering discharge. The pulse power density is in the range 1 – 3 $\mathrm{kW/cm^2}$, the pulse frequency 50 – 500 Hz and pulse length 50 – 500 $\mu$s. Measurements of the temporal and spatial behavior of the plasma parameters indicate peak electron density of the order of $10^{19}$ $\mathrm{m^{-3}}$, that expands from the target with a fixed velocity that depends on the gas pressure [3]. The high electron density results in a high degree of ionization of the deposition material. Fractional ionization of the sputtered material has been measured to be over 90% [4]. This is important since ions are controllable with respect to energy and direction as they arrive to the growth surface. The spatial and temporal variation of the plasma parameters, electron density, plasma potential, and electron and ion energy, in a HiPIMS discharge are explored. The plasma physics of the HiPIMS will be discussed as well as some of the applications of the HiPIMS technique.

[1] U. Helmersson, M. Latteman, J. Bohlmark, A. P. Ehiasarian, and J. T. Gudmundsson, Thin Solid Films **513**(2006) 1-24

[2] U. Helmersson, M. Lattemann, J. Alami, J. Bohlmark, A.P. Ehiasarian, and J.T. Gudmundsson, Proceedings of the 48th Annual Technical Conference of the Society of Vacuum Coaters, April 23-28, 2005, Denver, CO, USA, p.458

[3] J.T. Gudmundsson, J. Alami, and U. Helmersson, Surf. Coat. Technol. **161** (2002) 249 - 256

[4] J. Bohlmark, J. Alami, C. Christou, A. P. Ehiasarian and U. Helmersson, J. Vac. Sci. Technol. **23** (2005), 18-22