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**HIPIMS Arc Free Reactive Discharge for Deposition of Non-conductive Films on ENDURA 200 mm Cluster Tools.**Roman Chistyakov<sup>1</sup>, Bassam Abraham<sup>2</sup><sup>1</sup>Zond Inc, Mansfield, United States <sup>2</sup>Zpulsar LLC, Mansfield, United States

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Magnetron sputtering technology is widely used for the deposition of thin films for different applications. The properties of the sputtered films (metal, oxides, and nitrides) strongly depend on magnetron plasma density during the deposition process. The main problem for reactive sputtering is to generate stable arc free discharge and increase plasma density. One approach to generate arc free discharge is to use commercially available Pinnacle Plus Pulsed DC plasma generator manufactured by Advanced Energy Inc. This plasma generator is using the positive voltage between negative pulses to attract electrons and discharge target surface to prevent arc formation. But Pinnacle Plus plasma generator generates low density plasma and therefore does not allow controlling film properties in wide range. In 1995 -1999 a new way of magnetron sputtering was introduced. It was HIPIMS (highly ionized pulse impulse magnetron sputtering). The main idea of this approach is to apply short ( $\sim 50\text{-}100\ \mu\text{s}$ ) high power pulses with target power density during the pulse around  $1\text{-}3\ \text{kW}/\text{cm}^2$ . Highpower pulses generate high density magnetron plasma that allows significantly improve and control film properties. Until now there is no data were presented of HIPIMS reactive sputtering of nonconductive films on cluster tools for semiconductors, MEMS applications. In this presentation new method of generation arc free discharge for reactive HIPIMS with new plasma generator Cyprium (Zpulsar LLC) will be presented. It will be shown that arc formation in reactive HIPIMS can be controlled without applying positive voltage between pulses high power pulses. Arc free reactive HIPIMS process for sputtering  $\text{AlN}_x$ ,  $\text{TiO}_2$ ,  $\text{TiN}$  and  $\text{Si}_3\text{N}_4$  at ENDURA 200 mm cluster tool will be discussed. The direct comparison of the film properties sputtered with Pinnacle Plus plasma generator and Cyprium plasma generator will be presented.

**Keywords**

HIPIMS

reactive

sputtering

200 mm

cluster