

Laser and Plasma for Advanced Manufacturing (LPAM)

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Symmetric Magnet Pack for High Power Pulsed Magnetron Sputtering

Demand for high quality, high performance coatings has increased dramatically over the last few of decades due to their application in diverse industries. The automobile, tooling, medical devices and kitchen appliance industries, to name a few, incur very high tooling costs related to performance improvement of coating processes. In recent years, advancements in magnetron sputtering technology have made huge impacts especially in areas like low friction, wear-resistance, corrosion resistance and hardened coatings. High Pulsed Power Magnetron Sputtering (HPPMS) or High Power Impulse Magnetron Sputtering (HiPIMS) is a relatively new and promising pulsed magnetron technology capable of producing high quality, high performance coatings that were not achievable by conventional magnetron sputtering technology.



1. Hip replacement implants, coated by PVD. 2. A drill bit covered by PVD titanium nitride 3. Metal punches coated by PVD titanium nitride. 4. New magnet pack invented and produced by NSF-sponsored research which makes coatings at higher quality and faster.

Currently, the throughput of this breakthrough technology is relatively low. Hence, additional research and development will be required to fully implement it commercially. With the development of the new TriPack magnet pack for HiPIMS by researchers at the Center for Laser and Plasma Advanced Manufacturing (CLPAM), deposition rates in HiPIMS process have been doubled. These deposition rates are directly related

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to the throughput of the processes. Therefore, coatings with 10x better performance than conventional sputtering techniques can be achieved in about half the time. By using these TriPack coatings, the cost of products that contain coatings can be brought down considerably.

Economic impact: This invention along with the HiPIMS technology should be important for optical coatings where the performance is always plagued by the time spent on the coating process. It has been demonstrated that improved coatings from use of the TriPack magnet pack with HiPIMS technology will achieve exceptional performance leading to longer life times and lower costs. In the tooling industry, drill bits and milling cutters are often coated with titanium nitride or other specially engineered coatings through conventional magnetron sputtering technology. These coatings increase their lifetime by a factor of three or more. With this breakthrough's new TriPack development in the HiPIMS technology, superior titanium nitride coatings with about 5x more life time can be achieved at 10% lower cost. Because of increased wear-resistance and lower friction properties, coatings on an engine's camshaft, for example, could help increase the efficiency of engine performance by reducing friction losses by 40%. A patent titled "Method of and Magnet Assembly for High Power Pulsed Magnetron Sputtering" (# 14/878,417) was filed as result of this work. The leading industrial vacuum equipment provider, Kurt J Lesker Company, has plans to sell this magnet pack commercially.

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