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Self-sputtering initiation in high power impulse magnetron discharge on a hollow-cathodic effect enhanced cylindrical sputtering sources

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Self-sputtering can take place in high power impulse magnetron discharge by a very high power operation because of its high ionization rate of sputtered metal. To obtain self-sputtering more easily, an optimized cylindrical sputtering source based on the hollow-cathodic effect is designed. The discharge process is studied by the plasma global model. When the cylindrical sputtering source is operated by high-power impulse magnetron discharge mode, a higher ionization rate α and a higher probability of a sputtered and ionized atom return to the target β can be observed because of the hollow cathode effect. The sputtered unionized atoms will repeatedly sputter rather than runaway until ionize to further contribute α as a result of the physical structure of the cylindrical source. Meanwhile, more ions may collide on the opposite target leading to a much higher β than that induced by low potential only on conventional flat-target. Therefore, a smaller self-sputter yield γ which is positive related with the discharge voltage is needed for the cylindrical source to start self-sputtering.

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