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Advances in Powder-based Technologies for Production of High-Performance Sputtering Targets

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Abstract

The sputtering method has been extensively adopted for the production of high-performance thin films and coatings. This can be attributed to its versatility and flexibility, which allows easier tailoring of the properties and characteristics of the sputtered films and coatings for the desired application and performance. Contrary to thermal spray and chemical techniques, sputtering can be performed at room temperature for a wide range of targets, thus overcoming the challenges, such as residual stresses and degradation of the substrates, associated with high-temperature processes. The most important aspect of the sputtering is the target from which the thin film material is derived. The quality of the target determines the properties and performance of the resulting film and coating. Published data reveal that the quality of the targets depends mainly on the method of production. Although different manufacturing techniques have been used to produce these targets, consolidation of powders has been shown to provide outstanding results. The production of these targets through powder metallurgy depends on the compaction or sintering methods and associated processing parameters. With the increasing demand for high-performance thin films and coatings, such as high-entropy alloy films, the quality of the targets used for sputtering is crucial for application in various fields that include medical, electronics, and energy. In this article, progress on the powder metallurgy on the manufacturing of sputtering targets is detailed. Advances in various powder technologies, process parameters, and conditions, and their interrelationships with properties and performance of targets and sputtered thin films will be discussed, synthesized, and general/specific trends will be derived. This article will serve as a resource for metallurgists in the optimization and development of advanced targets for industry 4.0.

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