

## Advanced SPS Systems and FGM Technology

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Large-size ceramic/metal bulk FGMs have been fabricated on a recently developed and the world's largest Spark Plasma Sintering (SPS) systems. As a part of the development program for practical production processes and machines for FGMs by SPS, the processes, mechanical properties, dimensional size and shape effects, and production machine systems were investigated. In the past,  $ZrO_2/TiAl$ ,  $ZrO_2/Ni$ ,  $Al_2O_3/Ti$ ,  $WC/Co$ ,  $WC/Co/Steel$ ,  $Al/P$ , Polymide,  $Cu/Polymide$ , nano-composites, porous and other combinations of bulk FGMs have already been processed using SPS. However, most of the specimen sizes were small, in a range of 20 to 30mm in diameter. Recently disk-shape sintered compacts with diameters of 100 and 150 mm, and thickness of approximately 15 and 17 mm,  $ZrO_2(3Y)/stainless\ steel$  FGMs were homogenous consolidated in a shorter sintering time, while maintaining high quality and repeatability by utilizing a temperature gradient sintering method. The SPS heating up and holding time totaled less than one hour. Therefore, the SPS process is expected to find increased use in the fabrication of large-size FGMs as a new industrial processing technology. This paper introduces SPS systems, the processing principles, features and the characteristics of ceramic/metal bulk FGM.