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Determination of atomic diffusion coefficient via isochronal spark plasma sintering

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In the case of powder sintering during spark plasma sintering (SPS), the corresponding powder shrinkage and densification mechanisms are particularly interesting, given its specific physicochemical mechanism of spark generation and sputtering effects during neck formation between powder particles. Densification mechanisms are analytically correlated with specific physical quantities determined by the physical parameters, including densification rate (p), activation energy (Q), stress exponent (n) and comprehensive impact factor (f). In fact, the individualized scientific issue in SPS is the diffusion behavior of atoms induced by spark generation under high density pulsed electric current. Unfortunately, as a direct physical quantity that represents the ability of mass transfer governing densification mechanism of powder particles, an atomic diffusion coefficient (D) during SPS has heretofore never been attempted analytically and derived quantitatively. Concomitantly, metallic glass powders are frequently consolidated via SPS to fabricate novel bulk alloys with finer grains, such as fully amorphous, equiaxed ultrafine grain and bimodal microstructures, to name a few examples. Qualitatively, the formation mechanism of the finer grain microstructures has been attributed to the individual diffusion of atoms in a relative short SPS time. Hence, we first attempt to establish a framework that can be used to derive the value of a coefficient D, which can clarify the underlying densification mechanism during SPS of Ti40.6Zr9.4Cu37.5Ni9.4Sn3.1 metallic glass powders. Interestingly, the value of the derived D for the atomized metallic glass powder is always lower than that of the milled counterpart.

Biography

Xinxin Li is a Doctoral candidate from South China University of Technology. He has submitted two papers into Scripta Materialia (under review).

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