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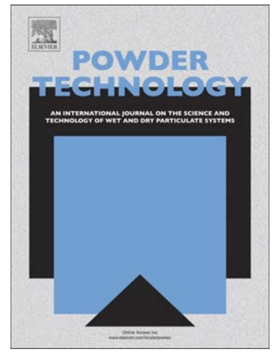

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Process-structure-property relationships of the comminution processing of Al scrap

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Abstract

The comminution of Al scrap was investigated under different processing conditions to assess its ability to tailor powders for the powder metallurgy (PM) industry. Specifically, the influence of the circumferential velocity and ventilation power over the properties of the pulverized particles was highlighted. These parameters controlled the residence time and deformation experienced by the feedstock chips, which, in turn, governed the size, morphology and composition of the pulverized particles. The pulverized chips consisted of heavily passivated oxide-dispersion strengthened (ODS) particles with varying contents of Fe, Si and Mn, depending on the extent of oxygen accumulation and contaminants embedding taking place during comminution. Upon screening, the -140 mesh pulverized powders were also characterized. The passivation layer thickness and Al_2O_3 dispersoids content of these powders ranged, respectively, from 6.81±0.31 nm to 7.58±0.38 nm and from 2.13±0.11 wt% to 5.20±0.11 wt% as circumferential velocity decreased, while they ranged from 4.96±0.41 nm to 8.67±0.36 nm and from 2.02±0.09 wt% to 7.12±0.09 wt% as ventilation power decreased. These tendencies highlighted that the oxygen enrichment process occurring during comminution changed from a passivation layer thickening regime to an Al_2O_3 dispersoids accumulation regime, for a residence time of ~210s. Furthermore, all pulverized powders contained nanograins whose fractions depended on the comminution parameters used.

Keywords (6): Aluminium; Scrap; Comminution; Passivation layer; Powder metallurgy; Oxide-dispersion strengthening

1. Introduction

Faced with the growing depletion of natural resources, the processing of scrap materials have become a necessity in order to reduce our carbon footprint and ensure the sustainable development of human activities [1, 2]. In the Al industry, the case of the used beverage cans (UBC) illustrates well the profitability and positive environmental impacts included in closed-loop recycling [3]. Consequently, further efforts were devoted to the improvement of recycling methods for Al components coming from several sectors including the automotive and aerospace industries [4, 5]. However, the majority of the proposed recycling routes consisted of cascade processing combining successively