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Data Article

Data on the densification during sintering of binder jet printed samples made from water- and gas-atomized alloy 625 powders

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ABSTRACT

Binder jet printing (BJP) is a metal additive manufacturing method that manufactures parts with complex geometry by depositing powder layer-by-layer, selectively joining particles in each layer with a polymeric binder and finally curing the binder. After the printing process, the parts still in the powder bed must be sintered to achieve full densification (A. Mostafaei, Y. Behnamian, Y.L. Krimer, E.L. Stevens, J.L. Luo, M. Chmielus, 2016; A. Mostafaei, E. Stevens, E. Hughes, S. Biery, C. Hilla, M. Chmielus, 2016; A. Mostafaei, Y. Behnamian, Y.L. Krimer, E.L. Stevens, J.L. Luo, M. Chmielus, 2016) [1–3]. The collected data presents the characterization of the as-received gas- and water-atomized alloy 625 powders, BJP processing parameters and density of the sintered samples. The effect of sintering temperatures on the microstructure and the relative density of binder jet printed parts made from differently atomized nickel-based superalloy 625 powders are briefly compared in this paper. Detailed data can be found in the original published papers by authors in (A. Mostafaei, J. Toman, E.L. Stevens, E.T. Hughes, Y.L. Krimer, M. Chmielus, 2017) [4].

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Specifications Table

Subject area	*Materials Science and Engineering*
More specific subject area	*Additive Manufacturing of nickel superalloy 625*
Type of data	*Figures*
How data was acquired	*Characterization of gas- and water-atomized powders and BJP sintered samples were conducted using scanning electron microscopy (SEM), micro-computed tomography (micro-CT), laser particle analysis and optical microscopy (OM).*
Data format	*Analyzed*
Experimental factors	*A powder bed binder jet printer (M-Flex ExOne) was utilized to produce alloy 625 parts made of two differently atomized powders, water-atomized (WA) and gas-atomized (GA), with the following printing parameters: layer height of 100 µm, recoat speed of 130 \ mm/s, oscillator speed of 2050 rpm, roller speed of 250 rpm, roller traverse speed of 15 mm/s, and drying speed of 17 mm/s*[1–3].
Experimental features	*After printing, BJP parts ("green parts") were cured at 175 °C in a JPW Design & Manufacturing furnace and then sintered in a Lindberg tube furnace in an alumina powder bed under vacuum with the following heating profile: heating at 5 °C/min from RT to 600 °C, 3.2 °C/min to 1000 °C, 2.8 °C/min to the holding temperature (1225 °C, 1240 °C, 1255 °C, 1270 °C, 1285 °C, and 1300 °C), holding for 4 h and then cooling at 1 °C/min to 1200 °C, 3.1 °C/min to 500 °C and finally to RT with a temperature stability of 1 °C*[3].
Data source location	*University of Pittsburgh, Pittsburgh, Pennsylvania, United States*
Data accessibility	*Data is with the article*

Value of the data

- The presented printing parameters assist researchers in obtaining the highest green part density of binder jet printed samples of other Ni-based alloys.
- Data allows one to determine process-property relationships for binder jet printed parts as well as the effect of different atomization methods on the densification and morphology of the BJP sintered samples.
- A detailed data overview on the densification of BJP alloy 625 may help in designing the additive manufacturing process.

1. Data

The data presented here can be divided into two parts: (1) characterization of the two atomized powders including gas- and water-atomized powders (Fig. 1) and (2) densification observation of the BJP alloy 625 samples made from gas- and water-atomized powders in terms of optical microscopy micrographs (Figs. 2–4). The microscopy observations and density measurements conducted in this paper are based on experimental results presented in the publication from the authors [4].

2. Experimental design, materials and methods

Brief data overview of powder characterizations on the GA and WA powders are illustrated in Fig. 1. The data presented here includes powder size, shape, morphology and internal porosity collected using SEM, micro-CT and particle size distribution.