Selective laser melting (SLM) is an additive manufacturing technology that can fabricate complex engineering components using a scanning laser beam to melt consecutive layers of powders with characteristics that significantly influence material properties. Present work investigates both the gas atomization and SLM processes for the Al10SiMg alloy with a focus on establishing the relationships among atomization parameters, powder characteristics, SLM parameters and materials properties. Al10SiMg alloy powders (Al-10wt.%Si-0.5wt.%Mg) were batch-produced through gas atomization by systematically varying the melt flow rate (0.012 - 0.037 kg/s), gas pressure (1.4 - 3.1 MPa), and melt temperature (850°C - 1000°C). The highest yield of 80 wt.% was accomplished for powders with particle size smaller than 75um, considered suitable for SLM, utilizing gas pressure of 2.7 MPa, melt flow rate of 0.020 kg/s, and melt temperature of 950°C. Investigations for the SLM process were carried out to identify the optimal particle size distribution (PSD) and critical reuse limit for Al10SiMg powders. Five distribution ranges (<45um, 20um < x < 63um, < 75um, < 106um, 75um < x < 106um), and five sets of recycled powder (new, one, five, ten and over twenty uses) were used to build SLM samples for metallographic and mechanical characterization. Archimedes' method, optical, scanning electron microscopy and mechanical testing in tension were employed to assess the influence of powder feedstock on part density, microstructure and mechanical properties, respectively. All PSDs examined in this study produced samples with over 99% relative density, but samples built with size range of 75um < x < 106um yielded the highest tensile and yield strengths of 448 MPa and 265 MPa, respectively. Results from recycling demonstrated that Al10SiMg alloy powders can be reused in SLM without sacrificing quasi-static tensile properties.

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The public is welcome to attend.