# Guest Editorial

## Special Section on Micro- and Nano-Additive Manufacturing—Part 2

Products with micro- and nano-scale features find widespread applications in industries including the medical, automotive, optics, electronics, energy, and biotechnology sectors. The tendency toward miniaturization and development of products in many industries exposed the limitations of established micro- and nanomanufacturing methods in terms of processing capability, speed, flexibility, accuracy, scalability, etc. To respond to these challenges, many micro- and nano-additive manufacturing (AM) technologies have been developed. Compared to traditional micro/nanofabrication methods, AM has the merits of simpler processing, shorter fabrication time, lower cost, and the capability of fabricating high aspect ratio structures and almost any complicated freeform structures. The innovation of novel AM or hybrid processes for micro/nanofabrication is a field of active research throughout the world. Accordingly, characterization, control, modeling, and simulation of the manufacturing process is in great need for achieving accurate and reliable production of micro/nanoscale features. In addition, successful production of complicated features at micro- or nano-scale requires understanding of the materials used as feedstock, and the relationships between feedstock materials, designs, processes, and properties of fabricated micro/nanoscale structures. Analysis of micro/nano-AM process performance, in terms of manufacturing flexibility, reliability, cost, and quality, is also critical to enable more applications in fields including biomedical, mechanical, sensing, actuating industries, etc.

To advance research in the above areas, the Micro- and Nano-Additive Manufacturing Symposium was initiated at the 2017 ASME Manufacturing Science and Engineering Conference held in Los Angeles, CA. This Special Section issue of the *ASME Journal of Micro- and Nano-Manufacturing* publishes peer-reviewed research papers from presentations given at this symposium.

Yu et al. presented a novel multiphoton polymerization three-dimensional (3D) printing process using femtosecond Bessel beam. A wire with average diameter of 100 $\mu$m and length exceeding 10 mm was successfully printed using the proposed technology. The femtosecond Bessel beam allows a layerless photopolymerization process, enabling a much faster build speed. A speed ten times faster than that of a layer-by-layer photopolymerization 3D

printing method was reported. Shi et al. studied the relationship of the microstructure and mechanical properties of graphene nanoplatelets-reinforced aluminum alloy AlSi10 Mg fabricated by selective laser melting. They found that graphene nanoplatelets increased the porosity and deteriorated the tensile strength of the fabricated composite. Cullinan et al. investigated the sintering processing window for Cu nanoparticles using different laser sources, including femtosecond, nanosecond, and continuous-wave lasers. Optimum sintering windows for Cu nanoparticles using those lasers were identified. A simplified model was also developed for estimating the ideal sintering window for metal nanoplatelets using pulsed lasers. The work showed that the model was useful in identifying the maximum power requirement for sintering. Pan et al. characterized the correlation between microscale magnetic particle distribution and the magnetic-field-responsive performance of 3D-printed composites. The yield stress of particle-polymer suspensions was used to predict the saturation magnetization and the trigger distance of the cured composites accurately. Zhou et al. presented a tool path planning method for directional freezing-based 3D printing of nanomaterials. One of the key challenges in the directional freezing-based 3D printing process is heat management. In their work, a novel heat prediction approach and a heuristic tool path planning method based on the prediction results were developed. They showed that the proposed tool path planning approach effectively improved the uniformity of the temperature distribution and hence enhanced the performance of the fabricated nanostructures.

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