Copper (Cu) and Cu-alloy are good candidates for the engineered components that require good thermal and electrical conductivity. Since industry often needs sophisticated components that cannot be made easily by traditional methods, such as casting, forging and machining, research for additive manufacturing of copper-based alloy is on demand. Therefore, this thesis focuses on the optimization of laser powder bed fusion (LPBF) of Cu-10 wt.% Sn alloy and pure Cu based on their characteristics such as relative density/porosity, surface roughness, phase constitutes, melt pool dimension, and dendrite arm spacings dimension, determined by optical microscopy, X-ray diffraction and Scanning electron microscope. LPBF, also known as selective laser melting, was carried out for the Cu-10Sn alloy with varying parameters of laser power from 200W to 350W, laser scan speed from 100mm/s to 1000mm/s, hatch spacing from 0.06mm to 0.21mm, and slice thickness of 0.03mm. Relative density of 98% to 100% by Archimedes Principle and nearly 100% by image analysis were obtained for a large range of parameters for Cu10Sn samples, which shows a very good printability of Cu10Sn over a large window of processing parameter. alpha-FCC Cu and delta-Cu41Sn11 phases were observed on the printed Cu10Sn samples. Flaws related to keyhole and lack-of-fusion were observed according to the energy input estimated by energy density of LPBF. Melt pool of all samples were measured, and its dimension had a linear relationship with the energy density. LPBF of pure Cu was also explored with varying parameters of laser power from 200W to 350W, laser scan speed from 50mm/s to 800mm/s, with a constant slice thickness of 0.03mm. Relative density of the LPBF pure Cu varied from 80% to 88%, and the flaws were mostly non-spherical, suggesting the lack of fusion to fully melt the Cu powder.

Major: Materials Science and Engineering

Educational Career:
Bachelor's of Materials Science and Engineering, BS, 2016, Harbin Institute of Technology

Committee in Charge:
Yongho Sohn, Chair, Materials Science and Engineering
Linan An, Professor of Material Science and Engineering
Yuanli Bai, Associate Professor of Mechanical Engineering

Approved for distribution by Yongho Sohn, Committee Chair, on March 16, 2020.

The public is welcome to attend.