Laser Processed Condensing Heat Exchanger Technology Development

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Current state-of-the-art Condensing Heat Exchangers (CHXs) require non-permanent coatings which have a history of degrading over time, becoming hydrophobic, and potentially contributing to dimethylsilanediol (DMSD) production on a spacecraft. Ultimately, this type of heat exchanger must be uninstalled and sent back to earth for refurbishment, which is not an option for spaceflight beyond low earth orbit. These significant technical issues must be solved for deep-space spaceflight. In continued pursuit of a high reliability CHX, a silver, dimpled sub-scale Laser Processed CHX (LP-CHX) was designed and manufactured. The LP-CHX does not require a coating, but rather relies only on a femtosecond laser processed silver surface for condensing. This paper highlights the design, development, manufacturing, and testing of the LP-CHX as well as the laser processing of the silver surfaces. Additionally, further microbial growth testing and long duration laser processed condensing tests are reported. These studies conclude that silver laser processed surfaces significantly minimize microbial growth and fungal growth when compared to plain silver and stainless steel metals.