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Additive Manufactured Superconducting Cavities[1] ERIC HOLLAND, YANIV ROSEN, NATHAN WOOLLEET, NICHOLAS MATERISE, THOMAS VOISIN, MORRIS WANG, Lawrence Livermore National Laboratory, Livermore, CA 94550, JORGE MIRELES, The University of Texas at El Paso, W.M. Keck Center, El Paso, TX 79968, GIANPAOLO CAROSI, JONATHAN DUBOIS, Lawrence Livermore National Laboratory, Livermore, CA 94550 — Superconducting radio frequency cavities provide an ultra-low dissipative environment, which has enabled fundamental investigations in quantum mechanics, materials properties, and the search for new particles in and beyond the standard model. However, resonator designs are constrained by limitations in conventional machining techniques. For example, current through a seam is a limiting factor in performance for many waveguide cavities. Development of highly reproducible methods for metallic parts through additive manufacturing, referred to colloquially as 3D printing, opens the possibility for novel cavity designs which cannot be implemented through conventional methods. We present preliminary investigations of superconducting cavities made through a selective laser melting process, which compacts a granular powder via a high-power laser according to a digitally defined geometry. Initial work suggests that assuming a loss model and numerically optimizing a geometry to minimize dissipation results in modest improvements in device performance. Furthermore, a subset of titanium alloys, particularly, a titanium, aluminum, vanadium alloy (Ti 6Al - 4V) exhibits properties indicative of a high kinetic inductance material.

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