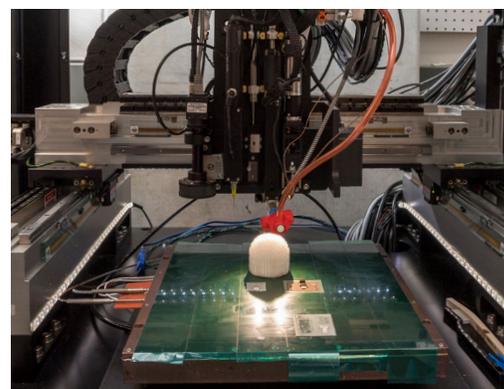
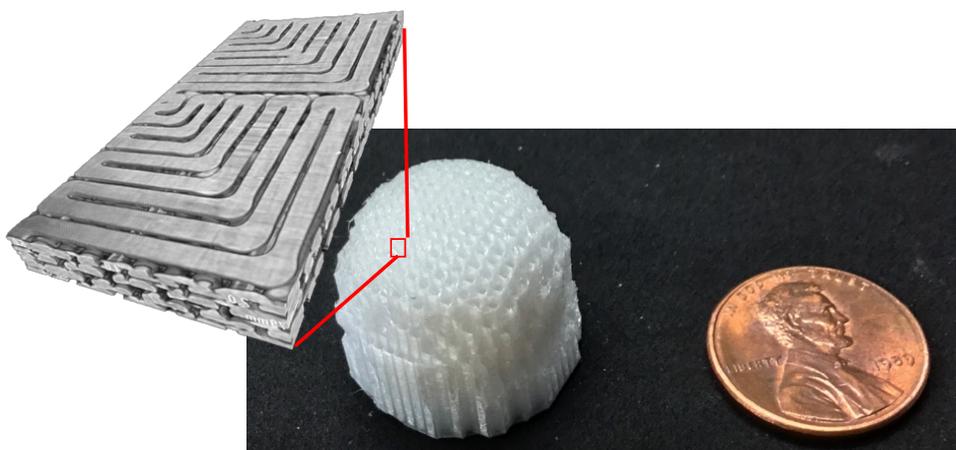


# ADDITIVE MANUFACTURING

UD-CCM is expanding its capabilities to include a focus on additive manufacturing, building on our history of additive processes for composite manufacturing. We are developing innovative hardware and processes for multi-material manufacturing, high performance feedstocks for mechanical and electromagnetic properties, and software codes for multifunctional design. Hardware and process development includes custom deposition heads capable of in-line composition and microstructural control with sensor-based feedback. Steerable feedstock capable of matching mechanical properties of continuous fiber composite materials with aerospace quality is in development, along with material compositions and strategies for tailored electromagnetic properties (conductivity, dielectric, and magnetic). Software codes that develop graded property designs taking advantage of additive flexibility are being developed and validated. The Lunenburg Lens project (lower left image) is an example of the unique capabilities at UD. In this case: (1) design software and processing codes were developed in order to allow for printing the lens as one continuous line using variable space filling curves; (2) a thermoplastic feedstock with optimized dielectric and mechanical properties was synthesized to match electromagnetic simulations; (3) hardware modifications allowed for deposited line widths of 25  $\mu\text{m}$ ; and (4) the result is a novel spherically symmetrical gradient-index lens that could not be manufactured in any other way.

“Since 1974, CCM has been a leader in composites manufacturing, from design to materials selection to testing to evaluation,” says Jack Gillespie, director of UD-CCM. “We are growing on that foundation by expanding to additive manufacturing and design.” By leveraging the material, modeling and process expertise UD-CCM has built over years as an internationally recognized center of excellence in composites manufacturing, we are developing advanced manufacturing solutions for structural and functional device fabrication that would not be possible otherwise.



**45 YEARS** OF INTERNATIONALLY  
**RECOGNIZED EXCELLENCE**  
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