

ABSTRACT:

Additively Manufactured Microwave Components for Sustainable Future

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Recent progress in microwave materials, multi-material printing, and digital fabrication has accelerated interest in additively manufactured radio-frequency (RF) electronics, especially for next-generation antennas and integrated microwave circuits. These technologies are changing how engineers design and realise hardware by enabling rapid prototyping, on-demand customisation, and shorter development timelines. Compared with conventional subtractive methods, additive manufacturing enables localised, low-volume production with intricate geometries, improved material efficiency, and reduced waste. A growing range of 3D-printed RF devices, including phased arrays, dielectric lens antennas, embedded sensors, and functional metastructures, demonstrates strong potential for tightly integrated wireless and sensing platforms. Their ability to co-design structure and function makes them particularly attractive for compact, multifunctional systems. Moreover, distributed manufacturing and print-on-demand workflows help reduce reliance on complex supply chains, contributing to more sustainable engineering practices. This talk explores emerging conductive and dielectric multimaterial additive manufacturing in the design, fabrication, and system integration of 3D-printed microwave and RF components, highlighting performance trade-offs, material considerations, and application-driven optimisation. As global demand for electronics continues to expand, there is growing pressure to adopt sustainable technologies in production paradigms. Additive manufacturing addresses this need by enabling resource-efficient fabrication and supporting electronic design strategies, with the potential to reduce lifecycle emissions under optimised conditions. In the context of 5G, 6G, and beyond, lightweight, portable, and application-specific 3D-printed RF systems are expected to play a key role across domains such as personalised healthcare, wearable devices, and biomedical diagnostics.