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Dielectric resonator array rectenna for radio frequency energy harvesting

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This paper presents a dielectric resonator array rectenna designed for radio frequency (RF) energy harvesting in the 2.4 GHz WiFi band. The rectenna is based on a 2×2 array of horizontally oriented cylindrical dielectric resonator antennas (CDRAs) – a configuration that, unlike conventional vertically placed elements, offers a low-profile structure with broadside radiation and wide angular coverage, making it well suited for harvesting ambient RF energy arriving from multiple directions.

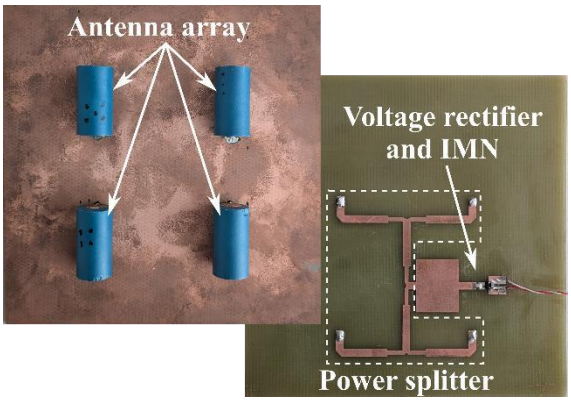

Fig. 1 CDRA antenna array and feeding network with integrated voltage rectifier and impedance matching network (IMN) manufactured using SSAIL.

The array, fed by a corporate microstrip network based on cascaded quarter-wave power dividers, achieves measured realized gains of 5.7 dBi at 2.4 GHz and 10.7 dBi at 5.4 GHz. Building on this array design, two rectenna topologies are proposed and compared: a centralized architecture employing a single rectifier connected after a 4-to-1 power combiner, and a distributed architecture featuring four individual rectifiers, one integrated at each antenna element. Both topologies are realized using SSAIL (selective surface activation induced by laser) fabrication technology, enabling compact, planar integration of the rectifying circuits directly within the feed network [1]. The conductor quality of the fabricated structures was verified through resistance measurements.

The proposed comparison offers insight into the trade-offs between circuit complexity, impedance matching, and RF-to-DC conversion efficiency in multi-element rectenna systems, contributing to the development of compact and scalable energy harvesting solutions for wireless sensor networks and IoT.

REFERENCES

[1] Ratautas, K. "Evaluation and optimisation of the SSAIL method for laser-assisted selective electroless copper deposition on dielectrics" Results Phys. 19, 103432 (2020).

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