Ambient Energy Harvesting Flexible Additively-Manufactured Topologies

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In recent years, the desire for a "smart" society, which utilizes technologies such as large scale sensor networks, Internet of Things (IoT) and smart skins is getting increasingly higher. One of the biggest issues to realize the autonomous operation of these sensors and devices is power supply. In order to solve this problem, ambient energy harvesting technology has attracted the interest of the research community in the last couple of decades. There are many different types of potential energy sources for ambient energy harvesting such as solar, heat and vibration. Among them, ambient microwave energy harvesting, because of its inherent applicability even through opaque walls, making it potentially more available than other ambient energy sources. There are many different types of available microwave signals, especially in urban environments, such as VHF/UHF TV and WiFi signals, although typically their energy density is lower than other sources. As the most fundamental implementation issues associated with the low energy density and the characteristics of Schottky diodes, which are commonly used for RF-DC conversion circuit implementation, it is very difficult to achieve a high enough output voltage that can drive external circuitry. In addition, most ICs require more energy than that required for normal operation when they need to activate from "cold start", further complicating the turn-on of the ICs using RF energy harvesters. In order to alleviate this problem, for example, a charged capacitor is utilized to guarantee the start up of ICs.

However, there are numerous "hotspots" where RF energy is fairly high, which can possibly provide enough energy to turn on external circuitry from cold start without using any supplemental energy sources. As an example, the two-way talk radio, which is a commonly used device for short-distance communication, does not use any base station and directly sends the signal to the other mobile devices. Therefore, it generates a relatively high RF power compared to other mobile communication electronics, especially in near field. In this paper, various examples of additively manufactured far-field and near-field energy harvesting topologies on flexible substrates will be presented and tested in terms of applicability to easy-to-scale IoT and wearable sensor applications.