Electromagnetic energy recovery on flexible substrates for powering WBANs

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The MIM[1] team is working on radiofrequency (RF) energy harvesting. Thus, RF energy harvesting system are realized thanks to a dual band rectenna (0.9 GHz 2.45 GHz) able to power a 5µW digital clock. The system is developed on a conformable substrate (Kapton) allowing a better adaptation on the environment and an improvement in terms of portability, weight, and manufacturing cost. In collaboration with another team, an autonomous radio-powered sensor node has been developed. To complement the RF harvesting, solar energy has been chosen up, increasing the amount of energy available to power a sensor node. The system is thus totally autonomous and take care of power management, the processing of the data from the sensor and its encoding for retransmission using another antenna. Those two projects gave new research axes the team is working on.

The first one, with its flexible substrate, could be used for WBAN[2] applications. However, the induce effect is the coupling effect of the human body on the antenna, 10 dB transmission loss is measured on the frequency band used for energy harvesting. To answer to this challenge, the team is developing an AMC[3], placed between the antenna and the body, to allow only a RF frequency band to propagate on its surface and thus enhance the energy harvested. Moreover, metamaterial absorbers, more efficient, will replace the bi-band dipole antenna developed during the first project.

The second one opened the door of hybrid energy harvesting. Using only one source is not secure in term of reliability. RF waves may be the most ubiquitous in terms of energy source in the urban scenario, the available energy density still remains low and losses are expected due to the body. Thus, a second source could give more power and reliability to the sensor node. As a complementary source, human kinetic activities give up to 30 W that could be converted using piezoelectricity, electromagnetic (Maxwell-Faraday equation) or triboelectric effects. Literature shows multiple results of hybrid energy harvesting using as a second source piezoelectricity or electromagnetic but, at the lector knowledge, there is no existing RF/electrostatic harvester even though there is interesting prototype of electrostatic energy harvesting system for WBAN.

[1] **M**aterials **I**nteractions **M**icrowave
[2] **W**ireless **B**ody **A**rea **N**etwork
[3] **A**rtificial **M**agnetic **C**onductor