

# **Inkjet-Printed RFID and Wireless Sensor Nodes: The Final Step to Bridge Cognitive Intelligence, Nanotechnology and RF?**

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## **Abstract**

In this talk, inkjet-printed flexible antennas, RF electronics and sensors fabricated on paper and other polymer (e.g.LCP)substrates are introduced as a system-level solution for ultra-low-cost mass production of UHF Radio Frequency Identification (RFID) Tags and Wireless Sensor Nodes (WSN) in an approach that could be easily extended to other microwave and wireless applications. The talk will cover examples from UHF up to the millimeter-wave frequency ranges. A compact inkjet-printed UHF "passive-RFID" antenna using the classic T-match approach and designed to match IC's complex impedance, is presented as a the first demonstrating prototype for this technology. Then, it will briefly touch up the state-of-the-art area of fully-integrated wireless sensor modules on paper or flexible LCP and show the first ever 2D sensor integration with an RFID tag module on paper, as well as numerous 3D multilayer paper-based and LCP-based RF/microwave structures, that could potentially set the foundation for the truly convergent wireless sensor ad-hoc networks of the future with enhanced cognitive intelligence and "rugged" packaging.

This talk will also discuss issues concerning the power sources of "near-perpetual" RFID-based modules, including flexible miniaturized batteries as well as power-scavenging approaches involving thermal, EM, vibration and solar energy forms. The final step of the presentation will involve examples from wearable (e.g. biomonitors) antennas and RF modules, as well as the first examples of the integration of inkjet-printed nanotechnology-based (e.g.CNT) sensors on paper and organic substrates. It has to be noted that the talk will review and present challenges for inkjet-printed organic active and nonlinear devices as well as future directions in the area of environmentally-friendly ("green") RF electronic and "smart-skin' conformal sensor.