Printed RFID based on low cost polymer electronics

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Abstract

It is expected that printed organic electronics will open a new market of low-cost electronic applications. It will exist besides the already established market for conventional and more expensive Si-based technology. Methods of mass production will enable high volumes of new products like smart labels or printed RFID-Transponders. The feasibility of printed electronics is proven with hybrid multi-bit RFID-Transponder fabricated in a clean room. Further completely printed prototypes without individual ID codes are presented. Consequently, low-cost electronics can be mass-produced with printing methods at high volume as well as low cost.

Introduction

Organic semiconductors and conductors open completely new prospects for microelectronics. The use of organic materials has considerable advantages in the fabrication process as many of them can be processed in solution. Thus high volumes can be produced with the use of traditional printing processes. Now, with the availability of organic semiconductors and conductors, completely new setups and applications can be realized. This will bring electronics even closer to nearly every product, as they can be produced as thin films on polymer substrates and applied on packages.

Technology

In order to prove the feasibility of organic electronics several devices were fabricated within a clean-room. Polymer rectifiers working at 13.56 MHz and fast integrated organic circuits up to 0.6 MHz are demonstrated. A 64-bit transponder operating at a supply voltage of ~ 14V was realized based on poly-(3-hexylthiophene) as p-type semiconductor material with charge carrier mobility of $\mu \approx$ 0.02 cm2/Vs. The polymeric devices are very stable and exhibit high electrical performance and lifetime. Since the polymeric materials used for our devices are all soluble, it is possible to fabricate our electronic circuits by a cost efficient roll to roll printing process. Thus, completely high speed printed and low cost polymer electronics can be realized.

First Products

First printed electronics products and prototypes have already appeared in 2007/08. These products have reduced complexities in comparison to silicon-based RFID chips. They target brand protection, anti-counterfeiting, product authentication, and presence control. For example, printed organic radio-frequency transponders were successfully tested at the MEDIA-TECH Expo in May 2008 (Frankfurt, Germany) by the Printed Smart Labels (PRISMA) project [1]. About 4.000 tags were used during the conference. The tags were produced with soluble polymers in a printing process. They operated at a reading frequency of 13.56 MHz but did not generate individual ID codes. In the application, radio frequency readers counted how many conference delegates attended the conference area.

References

[1] Homepage of PRISMA Project: www.prisma-project.de.

Author Biography

Alexander Knobloch studied physics in Erlangen and has taken his doctor's degree in printing of polymer microelectronic circuits at Siemens Corporate Technology at Erlangen. With the foundation of PolyIC in November 2003 he joined the Technology department of the company. He is Group Leader Product & Process and develops polymer RFID systems.