Intrinsic Conducting Polymer for Wi-Fi Electromagnetic Radiation and Environment Pollution Reduction

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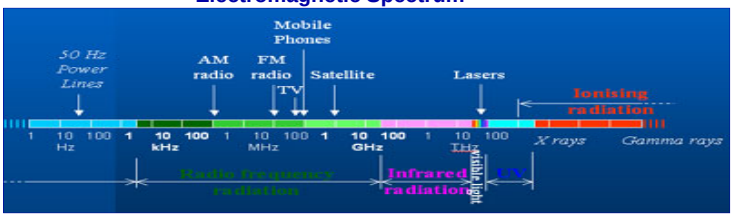
Abstract

Three intrinsic conducting polymers (ICP) polyaniline (PAni), polypyrrole (PPy) and PEDOT:PSS (Poly(3,4-ethylenedioxythiophene poly(styrenesulfonate)) are identified for use in mobile phone to replace the current conducting metal/carbon materials technology that are used in mobile phones. ICP could be used also used as Wi-Fi Electromagnetic (EM) Shielding in the current monile phone technology to replace metal/carbon parts. The ICP materials could be used to minimize the problems with Electromagnetic shielding (EMS), and therefore reduces the pollution in the environment from reducing the amount of metal/carbon that are used in the mobile phone. The research focuses on the Wi-Fi microwave frequency of 2.45 GHz and the testing of the ICP for transmission losses. Different ICP materials were tested in free space transmission experiments and compared to aluminium and micro-carbon.

Electromagnetic Spectrum



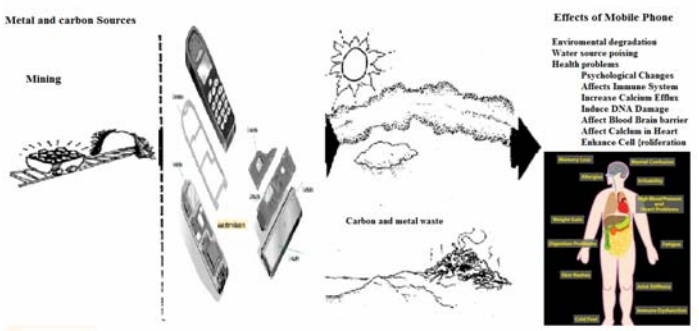
Introduction

As Wi-Fi and mobile phone systems increase in speed and design complexity, EM radiation emissions increase at a higher and higher frequencies that penetrate and damage human cells. The EM radiation needs to be reduced, and the EMI energy absorbed by different kind of materials, through use of appropriate coatings to focus the performance of Wi-Fi and mobile phone devices to its intended use rather than harming human cells . There are also the environmental issues of how safe and disposable of the current mobile phone materials. Electromagnetic (EM) radiation may cause symptoms such as insomnia, nervousness, languidness, and headaches. Moreover because the safety level is measured on the thermal damage level to the human cells and not the biological effect on human cells.

Current Mobile Phone materials

Metal flakes in a polymer matrix	Carbon fibres in a polymer matrix
Stainless steel fibres in a polymer matrix Expensive, Heavy, and prone to corrosion, while adding to the complexity and cost of manufacturing processes	Carbon nanotubes (CNT) graphite nanoplatelets (GNP). Health Hazard Nonotubes Very expensive material

Life cycle of current mobile phone materials



Mining pollution from metals and Carbon

•The chemicals and acidic materials from the used toxic parts of mobile phones is killing of aquatic life in the rivers and streams,
•The Pollution of buried mobile waste metals leaks into the ground water that destroy the soil and plants

Methods of testing materials EM shielding

Single/Double chamber method | anechoic chamber | Coaxial method | Open air method

•Open air experimental method is chosen to conduct experiments on comparing ICP with current conducting materials.
•Open air experimental for testing one of the ICP material (PAni) for its capability as a sensor

References
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[2] **Al-Shabib, Whamid;** Lachowicz, Stefan W and Bass, Octavian. Intrinsic conducting polymers for Wi-Fi electromagnetic interference shielding [online]. In: Asia-Pacific International Symposium and Exhibition on Electromagnetic Compatibility : **APEMC 2013**. Barton, ACT: Engineers Australia, 2013: 260-261. Availability: <http://search.informit.com.au/documentSummary;dn=445535531769696;res=IELENG> ISSN: 9781922107022. [cited 16 Sep 13].
[3] **Whamid Al-Shabib** and Stefan W. Lachowicz. Modelling of Polyaniline for Wi-Fi electromagnetic interference shielding, 2013 5th International Conference on Modeling, Simulation and Applied Optimization (ICMSAO13), IEEE Apr 28, 2013 .

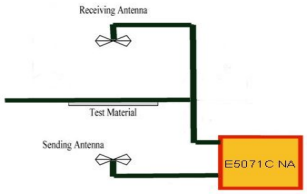
ICP Materials

The ICP materials were obtained from several companies, the polyaniline (salt) (PAni) from Sigma-Aldrich, PPy materials from Eeonyx Corporation, PEDOT:PSS from Heraeus Group and ordinary micro carbon conductive glue from QQL UK.

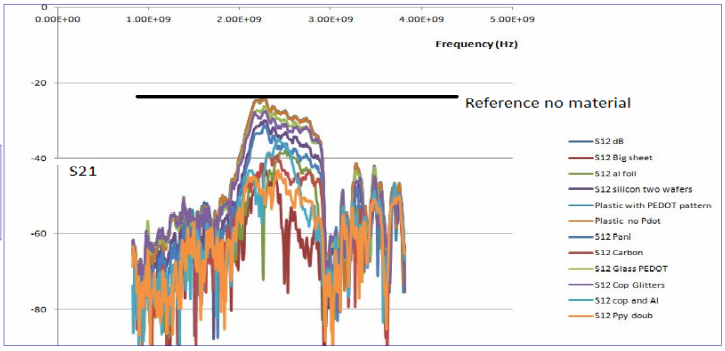
Open air experimental method

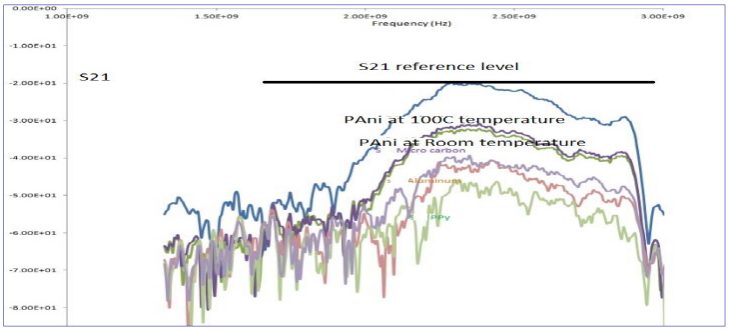
The open air experimental method has the following :-

- Aluminium screen of 190 cm by 115 cm
- Two Yagi a resonance frequency at 2.45 GHz, with a dielectric constant of 4.7 and a loss tangent of 0.025
- E5071C Network Analyser
- Ordinary glass slides 15 cm width by 15 cm length
- Liquid conducting polymer (Polyaniline salt)
- Liquid conducting polymer (PEDOT:PSS)
- Conducting polymer Polypyrrole (PPy)
- micro carbon conductive glue
- Copper



Results





Other Application of intrinsic conducting polymers

Electrostatic materials, conductive adhesives, printed circuited boards, artificial nerves, antistatic clothing, piezo ceramics, active electronics (diodes, transistors), aircraft structures, switches, molecular electronics, electric displays, chemical sensors, rechargeable batteries, drug release systems, optical computers, ion exchange membranes, electromechanical activators, and smart structures

Conclusions

- **ICP has a good conductivity**
- **ICP can be used with variable thickness**
- **ICP can have versatile usage**
- **ICP doping have a future in sensing**
- **ICP can be used as an anechoic chamber**
- **ICP can have versatile properties by changing the doping**

But there are factors that influence this method :

- **Antenna size and type**
- **Network analyser's operating frequencies**
- **Errors that are caused by mismatch and multiple reflections**
- **Material under test size**
- **Edge diffraction**