Tecnologie sostenibili

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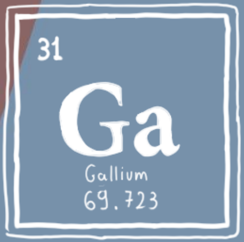
Introduction

In the electronic field the most commonly used materials are, firstly, Silicon, but in the last years it has also increased the use of Indium, Gallium, Lithium and Rare earth minerals.



In this power point we will focus on the problems concerning the use of Indium in the form of ITO and its possible replacements.

Uses of Indium

Indium is used in the form of ITO (Indium-Tin-Oxide): an oxide with impurities of tin, which makes it a electrical conductor.
Other properties of ITO are: transparency, humidity resistance and compatibility with existing industrial processes.
Therefore it is suitable for flat-panel displays, thin-film solar cells, smart windows and LED lights.

100 nm-thick layers of ITO are used to cover transparent glasses and plastics so that it’s possible to conduct electricity on the surface. This can be done because Indium is kneaded at low temperatures.

Indium related problems

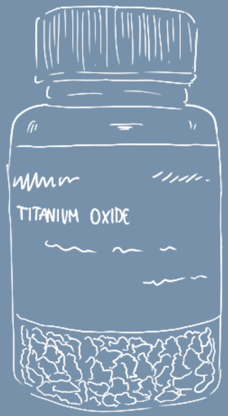
- Indium is rare, and it is believed a shortage will occur in the next 50 years
  - It’s only produced by China (290 tonnes), South Korea (195 tonnes), Japan (70 tonnes) and Canada (65 tonnes)

- It’s very expensive

- According to UNEP (United Nations Environment Programme) Indium recycling rate in 2011 was lower than 1%

ITO substitutes

- cadmium oxide → but it's difficult to use because of the toxicity of cadmium
- titanium oxide → but the temperatures of deposition and heat-treatment are very high
- multi-component oxides that contain a reduced amount of indium, e.g., ZnO– In2O3, In2O3–SnO2 and Zn–In–Sn–O → but the resulting amount of indium used in these materials is reduced to approximately half, a possibly insufficient amount



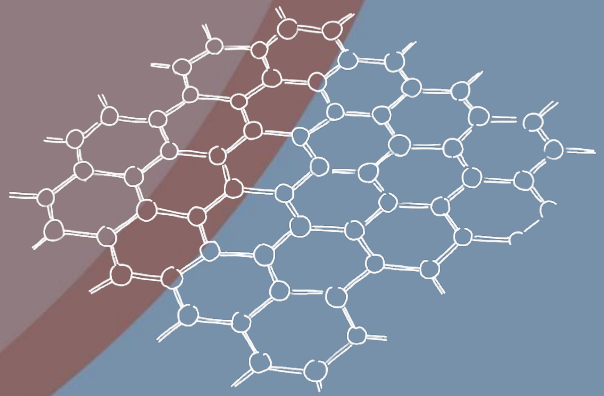
- ZnO, SnO2 and ZnO–SnO2 multi-component oxides → but impurity-doped SnO2 and SnO2-based materials are unsuitable for use in LCDs because of the difficulty of producing low resistivity films in depositions on low temperature substrates

The best, and only practical, indium-free candidate for an alternative TCO material is impurity-doped ZnO, in particular GZO and mostly AZO, which is suitable for use in LCDs

but the most important problems are the development of thin-film preparation techniques suitable for LCD applications and the improvement of stability in various environments of thin films with a thickness below approximately 100 nm

Graphene

Graphene is an allotrope of carbon consisting of a single layer of atoms arranged in a two-dimensional hexagon reticle.



Graphene is a relatively new material. It was first discovered in 2004 by Andrej Gejm and Konstantin Novosëlov, that were trying to obtain very thin graphite structures, with similar properties to carbon nanotubes.

Properties

conductivity: Graphene is an incredible conductor, due to its structure and two dimentional nature. While graphite conducts energy like any regular metallic material, with graphene the atoms are forced to travel with a two dimensional movement, almost assuming the characteristics of particles with no mass, while still remaining electrically charged.

This is also possible thanks to the symmetrical honeycomb-like structure of the material, that allows the electrons to travel 100 times faster than usual, even compared to silicon transistors.

Mechanical properties: The mechanical properties of graphene also are surprising: this material is incredibly mechanically stable:

- it can be modified and deformed, and withstand high pressures
- it conducts heat better than copper

Thanks to its structure, Graphene is basically impermeabile to external molecules and gasses, and is chemically stable when in contact with air and light.

Graphene can also be chemically modified to alter its properties, which makes it an extremely versatile material.

Applications of graphene

Due to its properties and versatility, graphene can have many uses:

- Solar panels
- Transistors
  - Graphene conducts electricity much faster than silicon
- Batteries
  - Graphene electrodes could better resist lithium ions penetrations than graphite, this can allow the batteries to last for longer
- Molecular filters
  - putting graphene foils with specific impurities on top of one another, they can work as a filter for nano-particles like molecules or DNA fragments

Current Limitations of graphene technology

- Graphene would make transistors work faster, but they couldn’t be stopped
    - The honeycomb-like structure lets both positive and negative charges pass at the same speed
- Both heat and electricity passage is hindered by imperfections and flaws where two foils are attached
- It can be difficult and expensive to apply Graphene to commercial goods

Why graphene is environmentally friendly

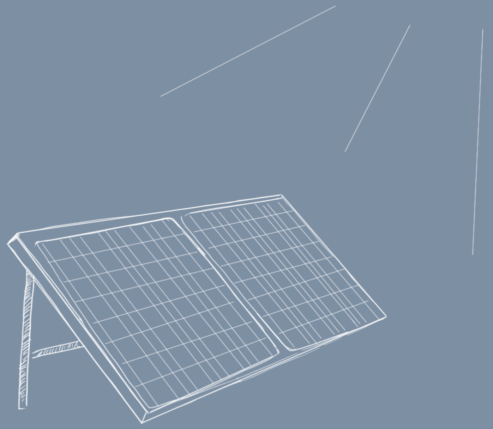
Biomedics
Graphene can be used for biomedical applications, like miniaturised sensors, implants, drug delivery systems and antimicrobial coatings

Affordable and Clean Energy
It has been studied the actual potential of graphene and layered materials to improve solar cells

Clean Water and Sanitation
At the moment graphene is being tested in water filtration systems, as for purification devices

Why graphene is environmentally friendly

Sustainable Cities and Communities
It can be incorporated into existing pollution removal technologies to improve their performance, like in the removal of pollutant gases from the atmosphere.



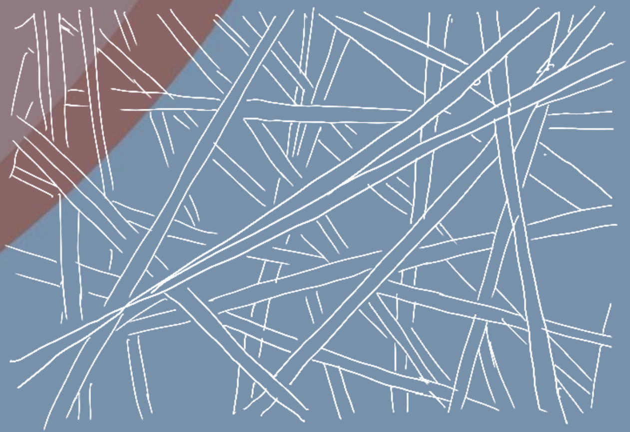
Responsible Consumption and Production
Graphene can alleviate their carbon footprint- for example graphene composites can be used to make lighter packaging, reducing costs and energy consumption.

Silver nanowires

Silver nanowires are a class of silver nanoparticles which have been studied for their possible use in several advanced technology applications, thanks to their exciting optical, thermal and electrical properties.

How they work
They are incredibly efficient at absorbing and scattering light

When silver nanowires are in solution, molecules interact with the nanowire surface to form a double layer of charge which prevents aggregation and stabilizes the nanowires.



Applications of Silver Nanowires

Silver nanowires find applications in

- Optical industries: Surface plasmons, medical imaging, solar films, Raman spectroscopy and optical limiters.

- Conductive applications: Touchscreen displays, high-intensity LEDs, and computer boards

- Antibacterial applications: Bandages, sterile equipments, clothing, paints and cosmetics

- Optical applications: Optical spectroscopies such as surface-enhanced Raman scattering and metal-enhanced fluorescence.

Future of Silver Nanowires

In recent years metal nanowires have been extensively studied for their optical properties, which has resulted in the development of several competing technologies to manufacture nanowires.

As out of all metals used as nanostructures, silver exhibits the best electrical conducting properties, with better flexibility and optical transparency, which are critical for manufacturing a number of electronic and optoelectronic devices.