Trinity College Dublin

Novel p-type Transparent Conducting Oxide

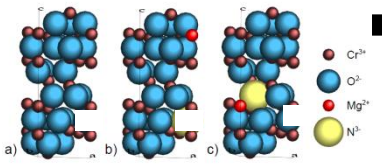
Available for license

Basic overview

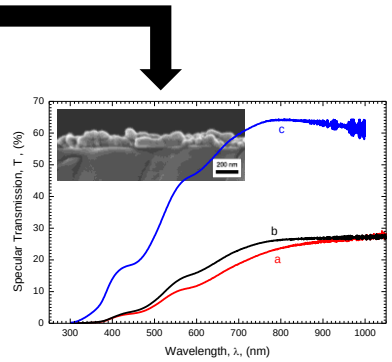
Researchers in Trinity College Dublin have developed a **novel material** showing **p-type semiconducting** properties while maintaining **good transmission in the visible range**. Electrical and optical properties are on par to other known p-type oxides such as delafossite $CuAlO_2$.

p-type transparent conducting oxides (TCOs) have multiple uses in optoelectronic devices such as thin film and dye-sensitized solar cells, organic light emitting diodes (OLEDs) or transparent thin film transistors. The new material can improve device performance or enable new devices, where current p-type TCOs have limitations in stability, band alignment or during material synthesis.

Stages of development:



Crystal structure of a) Cr_2O_3 and b,c) of the new found material Cr_2O_3:MgN.



Measured transmission of a) Cr_2O_3, b) Cr_2O_3:Mg and c) Cr_2O_3:(Mg,N) films.

Applications

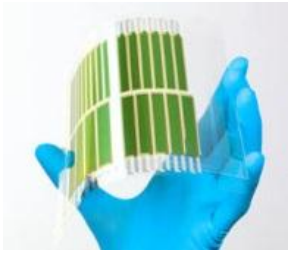
There are only a limited number of existing materials available which do show p-type conductivity and transparency at the same time. Currently, only laboratory test devices use such materials, as the available devices are either not conductive or transparent enough, are not compatible with the electronic structure of adjacent layers in a device, or are simply not stable.

This novel material overcomes some of these problems and could be used for:

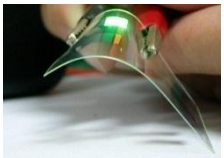
- Hole injector in organic light emitting devices (OLEDs)
- Fully transparent displays (window integrated electronics)
- Transparent lighting (window integrated OLED based lights)
- Hole injecting buffer layers in organic and thin film solar cells

Advantages

- The new p-type TCO is a **hard, robust** oxide suitable for top surface conductive coatings
- The new p-type TCO is **stable in air or N_2** at least up to 400°C and in oxygen rich environments at least up to 550°C, allowing growth of many other materials on top of the layers
- **No rare materials** are used in the new p-type transparent conducting oxide
- **Design principles transferable** to other semi transparent transition metal oxides, allowing improvement of other existing p-type TCOs
- The synthesis requires only **moderate temperatures** (500°C)
- The material requires no post annealing



Potential applications.



OLED and solar cell sourced from (Source: Wikimedia) and (Source: Heliatek).

The opportunity

Opportunities exist to licence this technology. At this stage the material design concept as well as test layers on glass are finished.

We are looking for device manufactures, who are interested in collaborative projects for the new material as well as equipment manufacturers (CVD, MOCVD, sputtering) who are interested in refining their tools for deposition of the new material.

Technology and patent status

A priority patent application was filed in 2011. There is on-going research on improving the material itself as well as demonstrations of delivery with other, technologically more relevant deposition techniques.

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