

Transparent coatings and see-through materials from heating

Many modern technologies are based on materials that are deposited on special underlying materials. Optical coatings can prevent tarnishing, give anti-reflection benefits, and in some cases filter out harmful UV rays. In consumer devices, many modern optoelectronic devices that make up a vast majority of electronic products such as active displays, touch screens etc. are based thin film transistors and transparent materials, as are parts of solar cells, smart windows, antireflection coatings for a range of devices and applications, anti-fingerprint and antifogging glass, among many other modern uses of see-through materials and coatings with well-defined characteristics in visible light.

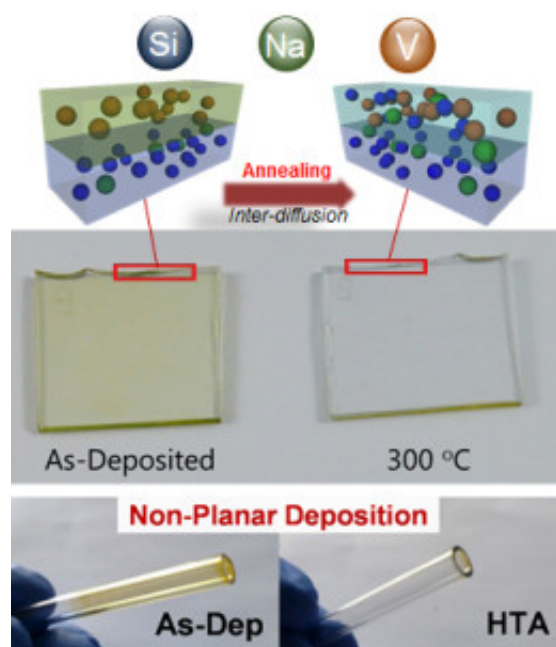


Fig. 1.

Since many technologies rely on light absorption and light transmission in different ranges. Take UV rays for instance: filtering UV is good for home windows, sunglasses with active colour control, car windows with antifogging coatings, but UV absorption from sunlight is required for efficient solar cells, for self-cleaning windows, and many other technologies. In electronic and optoelectronics, devices that use transparent materials are important as we move to much higher fidelity screens, multifunctional touch screen for home entertainment but also for higher security protection against unwanted access to our devices, ant. Underlying all of these technologies are a class of materials known as metal oxides.

While the science and technology of controlling materials into a whole host of electronics and photonic or optical devices has advanced considerably in the last decade, industry still requires all this to be done without using critical raw materials, expensive coating methods that are often very slow, and to do so at much lower temperatures for coating on to curved or flexible displays or materials – all without sacrificing quality that current methods provide.

As part of this search, we have uncovered a simple, yet powerful way of creating see-through coatings. At the core of the discovery is the ability to convert one material to another by heat, using the materials in the underlying material to diffuse into the coating to make it completely transparent, and to do so with a dip-coating method that can cover small or very large surfaces quite quickly. Using a material that is ordinarily yellow-brown in colour (see Fig. 1), it is converted to a completely transparent material by heating of the underlying glass. The substance within the glass interacts with the coating by diffusion, forming a uniform see-through film on a range of shaped surfaces. As part of the discovery, our work uncovered the mechanism by which this happens, and showed that metal oxide materials were converted to multi-metal oxides. In Fig. 2, we show how the optical transparency was significantly improved, and importantly, the material is broadband transparent; its see-through nature avoids absorbance within the material.

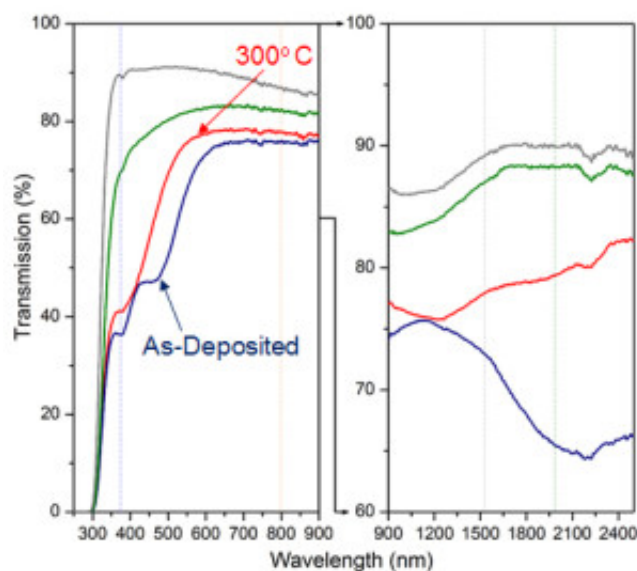


Fig. 2.

The method we have demonstrated provides a way to make transparent materials from typically coloured or opaque materials for a whole range of devices and systems, and hopefully for many different oxide materials with specific properties that are required for electronic devices. With the advent of transparent electronics, the ability to convert one coating into a transparent version by this method provides an option to make materials for see-through electronic materials for touch-

screens and flexible display technologies. Since the outside coating is formed using the composition of the underlying coating, it may be possible to apply this discovery to a range of materials with different properties, defined by the composition. In consumer devices, oil-resistant, or oleophobic, coatings could be developed for fingerprint-free surfaces, and because the coating is transformed to complete transparency directly on the surface, it should maintain very high scratch resistance.

Publication

[Solution processable broadband transparent mixed metal oxide nanofilm optical coatings via substrate diffusion doping.](#)

Glynn C, Aureau D, Collins G, O'Hanlon S, Etcheberry A, O'Dwyer C.

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