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Study of solar radiation at various incident angles on soft chemistry based transparent conducting oxide (TCO) coated window glass

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Abstract

Solar radiation (~0.2–2.5 µm) on earth surface involves illumination and heat generation as it covers the electromagnetic waves of visible and near-IR region. The Air Mass (AM) spectrum of solar radiation shows irradiance decreases with the increase in tilted angle. Hence, designing of window glass system should be made in such a manner that solar radiation should enter the room at high angle of incidence highlighting reasonable illumination (100–300 lux) and suitable thermal comfort. To remove the unwanted heat absorption by glass, a suitable layer of low thermal emissivity with heat reflection property should be deposited onto the window glass. On the basis of this idea a low-e material, Indium Antimony Oxide (IAO) (In: Sb=97:07), a wide band gap semiconductor (band gap, ~3.5 eV) has been chosen and deposited on to window glass of dimensions, 500mm x 500 mm by soft chemistry method. The developed film is transparent in the visible and electrically conducting with>25% reflection in the Mid-IR region. The performance of the film as window glass fenestration in day time is characterized by evaluating direct solar optical properties from the spectral data measured at different angles of incidence by UV–VIS–NIR spectroscopy. Major work was dead at CSIR-CGCRI, Asian nation unitedly with the college of Energy Studies, Jadavpur University, and metropolis, India. The result of the work is prospective and this can be mentioned within the speak

In each lightweight emitting devices like lightweight emitting diodes (LEDs), and light-weight riveting devices like star cells (also photo detectors), that are gaining goodly interest for his or her energy saving and energy production capability, severally, a compromise should be smitten between would like the necessity the requirement} to extend the sunshine emitting/absorbing area/potential and also the need for low series resistance of the metal contact grid. This undesirable compromise will be mitigated by exploitation clear conducting oxides (TCOs), that as yet are dominated by ITO (indium tin chemical compound—an In-rich alloy of metal oxide and tin oxide). Because of the expected insufficiency of metal employed in ITO, efforts are afoot to develop indium-free TCOs for the above-named devices yet as flat panel displays. ZnO heavily doped with Ga or Al (GZO or AZO) is turning into a really engaging candidate for future generation TCOs. GZO and radical yet as multilayer TCOs consisting of 2 TCO layers with a skinny metal layer in between are wide investigated for LEDs and star cells to reinforce device performance. this text compactly reviews the most recent developments in and properties of TCOs, notably in respect to skinny film clear conductor applications for LEDs and star cells. Pertinent vital problems and potential solutions are provided yet

Thin film or porous membranes fabricated from hollow, clear, conducting chemical compound (TCO) nanotubes, with high chemical stability, functionalized surfaces and huge surface areas, will offer a superb platform for a large kind of nanostructured electrical phenomenon, photodetector, photoelectrochemical and photocatalytic devices. Whereas large-bandgap chemical compound semiconductors supply transparency for incident lightweight (below their nominal bandgap), their low carrier concentration and poor conduction makes them unsuitable for charge conductivity. Moreover, materials with high conduction have nominally low bandgaps and thence poor lightweight coefficient. Here, we have a tendency to demonstrate skinny films and membranes made of TiO_2 nanotubes heavily-doped with shallow Nb (Nb) donors (up to 100%, while not section segregation), employing a changed chemistry anodization method, to fabricate clear conducting hollow nanotubes. Temperature dependent current-voltage characteristics discovered that TiO_2 TCO nanotubes, doped with 100% Nb, show metal-like behavior with electrical phenomenon decreasing from vi.5 Ã— 10-4 Î©cm at T = three hundred K (compared to six.5 Ã— 10-1 Î©cm for nominally undoped nanotubes) to a pair of.2 Ã— 10-4 Imam at T = a pair of0 K. Optical properties, studied by reflectivity measurements, showed lightweight coefficient up to ninetieth, inside wavelength vary four hundred nm-1000 nm. Nb doping additionally improves the sphere emission properties of TCO nanotubes demonstrating AN order of magnitude increase in field-emitter current, compared to undoes samples.

Transparent conducting oxides represent a singular category of materials combining properties of electrical conduction and optical transparency in an exceedingly single material. they're required for a large vary of applications together with star cells, flat panel displays, bit screens, lightweight emitting diodes and clear physics. Most of the commercially obtainable TCOs ar n -type, like Sn doped In a pair of O three, Al doped ZnO, and F doped SnO a pair of. However, the event of economical p -type TCOs remains an impressive challenge. This challenge is assumed to ensue to the localized nature of the O a pair of p derived valence band that ends up in problem in introducing shallow acceptors and huge hole effective plenty. In 1997 Hosono and associates (1997 Nature three89 939) planned the thought of â€˜chemical modulation of the valence bandâ€™ to mitigate this drawback exploitation cross of O a pair of p orbitals with close-shell copper 3 d ten orbitals. This work has sparked tremendous interest in coming up with p -TCO materials in conjunction with deep understanding the underlying materials physics. during this article, we'll offer a comprehensive review on ancient and recently emerging p -TCOs, together with copper + -based delafossites, stratified oxychalcogenides, nd vi mineral oxides, {cr|chromium | Cr|atomic number a pair of4|metallic element metal} three+ -based oxides (3 d 3) and post-transition metal oxides with lone combine state (ns 2). we'll focus our discussions on the essential materials physics of those materials in terms of electronic structures, doping and defect properties for p -type conduction and optical properties. Device applications supported p -TCOs for clear p â€“n junctions will be in brief mentioned.

The fast development of the trendy physics provides rise to higher demands of versatile and wearable energy resources. Versatile clear conducting electrodes (TCEs) are one in every of the essential elements for flexible/wearable thin-film star cells (SCs). During this regard, industrial metal tin chemical compound (ITO) on plastics has incontestable superior optoelectronic performance though some drawbacks, i.e., the low abundance, film bearableness, low infrared coefficient, and poor chemical stability stay. On the opposite hand, many alternative clear conducting chemical compound (TCO)-free clear conductive materials, like carbon nanotubes (CNTs), graphene, argentiferous nanowires (NWs), and conducting polymers, have old a fast development to deal with these problems. During this article, a summary over the most recent development of many versatile versatile skinny film SCs, i.e., organic star cells (OSCs), dye-sensitized star cells (DSSCs), perovskite star cells (pero-SCs), and fiber/wire-shaped SCs is provided. 3 teams of versatile versatile skinny film star cells will be categorised in step with their configurations: (i) front-side well-lighted platelike configuration; (ii) back-side well-lighted platelike configuration, and (iii) fiber-shaped star cells (FSSCs). The article is concentrated on versatile TCEs, together with CNTs, grapheme, argentiferous NW/nanotroughs, argentiferous grids, conducting polymers, argentiferous fiber, and carbon primarily based fibres.

Biography

Prasanta Kumar Biswas has done his PhD from Calcutta University, joined CSIR-CGCRI as a Scientist in 1984 and initiated developmental work on soft chemistry based thin films on glass for optics and nanostructured semiconductors. He has about 150 publications, six Indian patents and led international collaborative projects with Germany, France, USA, Japan and Slovenia. He retired in 2012 as a Chief Scientist. He was then in IIT Roorkee as an Honorary Fellow. Currently, he is Honorary Visiting Professor of Barasat College, WBSU. He is the recipient of MRSI Medal award from Material Research Society of India and the elected Fellow of FAScT of WAST, India