3-D INTERFACE AUGMENTED ULTRATHIN TRANSPARENT AND CONDUCTIVE METAL LAYER SUPPORTED ON SUBSTRATES AND METHODS OF FABRICATION

IITM Technology Available for Licensing

Problem Statement

- Transparent electrodes (TEs) are crucial in optical devices but ITO, a commonly used material, has limitations including high cost, fragility, and chemical incompatibility.
- Alternative materials like graphene, carbon nanotubes (CNTs), and metal nanowires face challenges like non-uniform properties and rough surfaces.
- **Ultrathin noble metal films (<20 nm) offer good optoelectrical properties but suffer from non-continuous growth** and increased surface roughness, reducing optical transmittance and conductivity.
- Surface roughness due to in-built substrate roughness and interfacial energy mismatch hinders the formation of continuous ultrathin high conductive metal films.

Intellectual Property

- IITM IDF Ref**. 2483**
- **IN 202241077010**

Technology Category/ Market

Category- Optoelectronics

Applications- Optoelectronics, plasmonics, solar cells, photovoltaic cells, organic light emitting diodes, integrated electro optic modulators, laser displays, photo-detectors.

Industry-Optoelectronics and Electronics Manufacturing

Market - Global thin and ultra-thin films market is expected to reach USD 22,812.53 million by 2029, registering a **CAGR of 15.4%** during 2022-2029.

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

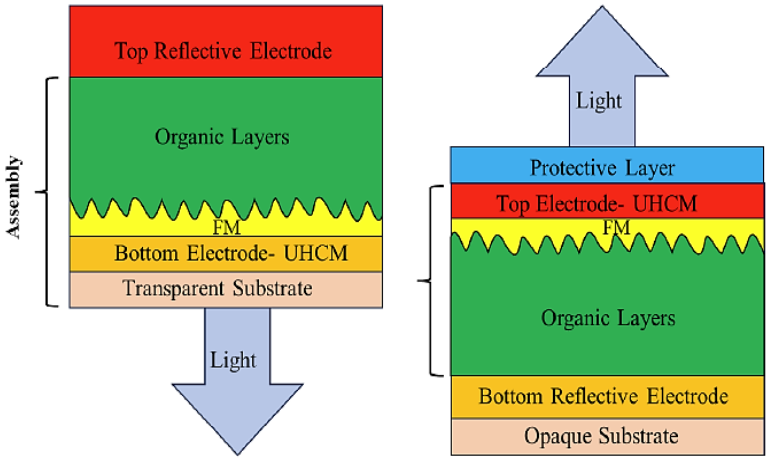

FIG.1. Schematic of the simplest form of the organic photovoltaic device with an ultrathin metal film based bottom electrode. FM layer acts as hole or electrons transport layer. HCM layer could be capped/protected by a dielectric layer.

Technology

The present invention relates to electrically conductive and transparent ultrathin film comprising a filler material (FM) and high conductive metal (HCM) film supported on substrate.

It is further disclosed a method of producing stable Ultrathin High conductive Metal (HCM) films comprising of following steps: a) thermal treatment b) FM deposition c) thermal treatment and d) HCM deposition and e) thermal treatment.

The present disclosure aims to provide the electrodes with better electrical conductivity, optical transparency, stability and compatibility with the environment.

Research Lab

Prof. Satyesh Kumar Yadav,
Dept. of Metallurgical and Materials Engineering

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

Key Features / Value Proposition

Enhanced Electrode Performance
- Continuous, smooth metal film layer serves as a superior electrode with improved electrical conductivity and optical transparency, enhancing overall device performance.

Industrial Scalability
- Easy integration into large-scale industrial processes facilitates cost-effective deposition of these advanced electrodes.

High-Temperature Resilience
- The assembly, consisting of substrate, FM, and HCM, can withstand annealing at temperatures up to 90% of the melting point (in Kelvin) of any of its three components, ensuring stability in high-

Broad Spectral Transparency
- The assembly is transparent to visible light and reflective to electromagnetic light in the IR spectral range, making it versatile for various optical applications.

Efficient Heat Transfer
- The 3-D interface between the substrate and HCM, facilitated by FM, promotes better heat transfer, enhancing device performance and longevity.

Anti-Diffusion Barrier
- FM acts as a barrier layer, preventing the diffusion of Ultrathin HCM into the substrate, ensuring long-term stability and reliability.

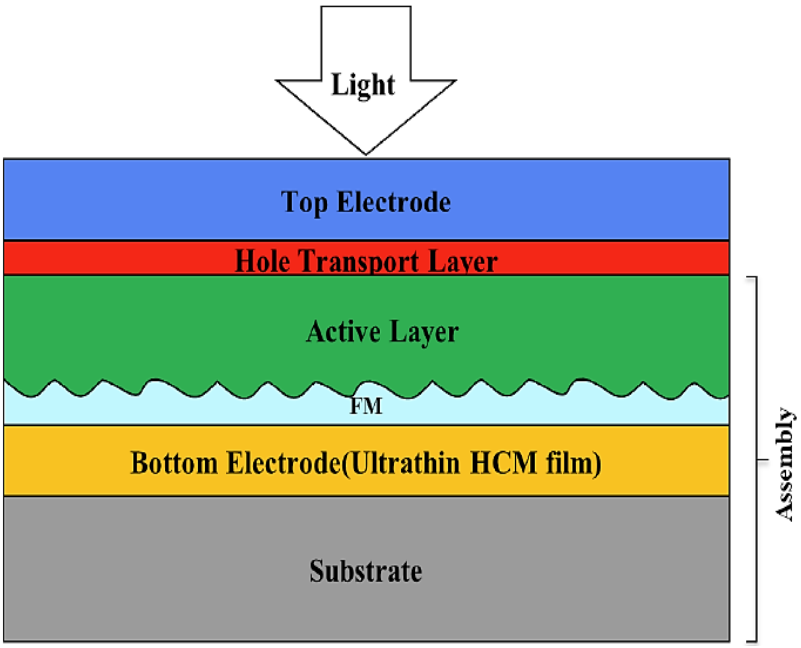

FIG.2. Schematic of the simplest form of the organic photovoltaic device with an ultrathin metal film based bottom electrode. FM layer acts as hole or electrons transport layer. HCM layer could be capped/protected by a dielectric layer.

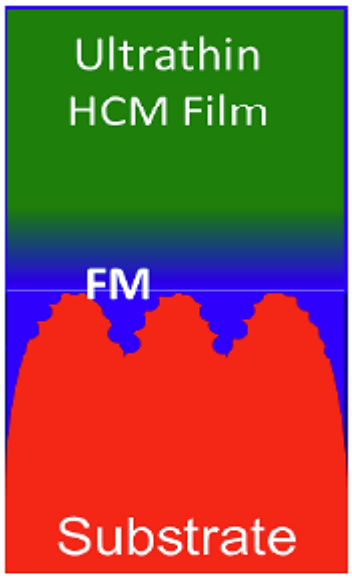

FIG.3. Schematic representation of Ultrathin Metal Layer Supported on Substrate with its roughness filled with Filler Material.

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719