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Microwave Process for Improved Optical & Electrical Properties in TCO Semiconductors

Transparent conductive oxide (TCO) layers are an important component of semiconductors within a number of electronic devices including solar cells, touchscreens, and light emitting diodes. Currently, indium tin oxide (ITO) is the most commonly used TCO material due its high electrical conductivity and high optical transparency. However, ITO lacks transparency for ultraviolet wavelengths and the scarcity of indium makes ITO fabrication very expensive. Zinc-oxide based materials are new and better alternatives due to their low toxicity, high carrier mobility, excellent environmental stability, and superior chemical selectivity. Indium gallium zinc oxide (IGZO), in particular, has higher transmittance, lower processing temperature, excellent surface smoothness, and requires less indium than ITO. IGZO also consumes less power than ITO, but is normally too electrically resistive for application as an electrode.

Researchers at ASU have developed a microwave process that improves both electrical and optical properties of IGZO-based semiconductors. Microwave annealing (heating and cooling procedure for strengthening material) saves time, conserves energy, and improves IGZO functionality as compared to conventional 24-hour furnace annealing. Microwave annealing enhances both electrical and optical properties of IGZO, whereas conventional annealing only improves IGZO's electrical properties. This process lowers IGZO resistivity and increases its transparency enough to make it preferred over ITO, resulting in lower-cost semiconductors with superior electrical and optical performance.

Potential Applications

- Light Emitting Diodes
- Optoelectronic Devices
- Touchscreens
- Smart Phone Panels
- Solar Cells

Benefits and Advantages

- Efficient – Microwave annealing saves time and energy as compared to conventional furnace annealing.
- Environmental – Less toxic than ITO for the environment.
- Inexpensive – Costs considerably less than ITO.
- Innovative – Improved transmittance for ultraviolet wavelengths.
- Practical – Consumes less power than ITO-based semiconductors.

For more information about the inventor(s) and their research, please see

Dr. Terry Alford's directory webpage