Thin-film transistor strategy to enhance flexible display panel performance

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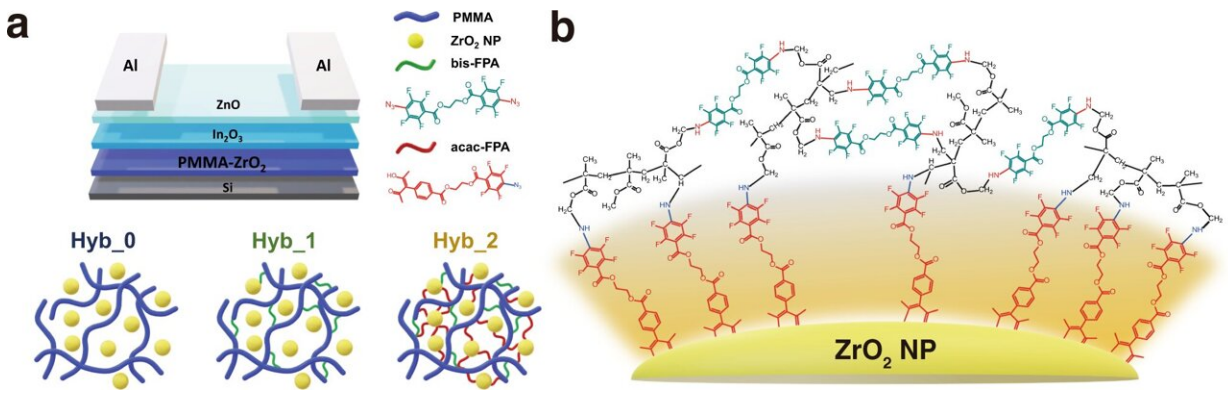

Schematic diagram of oxide TFT with hybrid dielectric using a crosslinking ligand. a Structure of In_2O_3/ZnO heterojunction TFT with PMMA-ZrO_2 as a gate dielectric (top) and molecular structure of Hyb_0, Hyb_1, and Hyb_2 (bottom). b Proposed structure of ZrO_2 NPs with acac-FPA as a chelating ligand and binding with polymer via azide chemistry whereas bis-FPA effectively crosslink polymeric backbone. Credit: *Nature Communications* (2022). DOI: 10.1038/s41467-022-34772-x

Advances in display technologies prompt the development of electronic products with foldable and flexible panels. Flexible displays have thin-film transistors (TFTs) built in that act as an on/off light switch for the display. At the same time, important considerations for the advancement of next generation displays include electrical charge transmission velocity, operation stability, and production cost reduction.

Recently, a research team at POSTECH has proposed a highly efficient crosslinking strategy for a dense and defect-free thin-film organic-inorganic hybrid dielectric layer. The findings from the study were published in *Nature Communications*.

The global evolution of IoT has raised interest in metal-oxide semiconductor-based circuits with low standby power consumption. Attention has been particularly keen on TFT materials capable of low-cost solution processing. Among several solution-processable semiconductors, metal oxides are regarded as the most successful material platforms for TFTs mainly because of their high charge carrier mobility and operational stability.

Professor Dae Sung Chung (Department of Chemical Engineering) and his team propose a highly efficient crosslinking strategy for organic-inorganic hybrid dielectric layers, which covalently connect inorganic particles to polymers. The researchers used azide-functionalized acetylacetonate to develop a dense and defect-free thin-film morphology of organic-inorganic hybrid dielectrics.

This approach reduces leakage current, allowing for driving at low power. Moreover, dielectrics with excellent physical properties can be manufactured through an easy-to-use solution process. This means the manufacturing cost of thin-film transistors be reduced while low-temperature thermal treatment is possible at the same time, allowing for them to be fabricated on flexible substrates.

Professor Chung, the lead researcher explained, "Our efficient and stable thin-film transistors will enable next-generation flexible electronic devices such as flexible electronics and wearables. The new oxide semiconductor material is expected to contribute to the development of basic technologies for memory, display, and other industries."

More information: Juhyeok Lee et al, Azide-functionalized ligand enabling organic–inorganic hybrid dielectric for high-performance solution-processed oxide transistors, *Nature Communications* (2022). DOI: 10.1038/s41467-022-34772-x

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