**Ambient-Stable p-Type Transparent CuI Thin-Film Transistors via Room-Temperature Pulsed Laser Deposition**

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As the first discovered p-type transparent conductive material, copper(I) iodide (CuI) is considered to be among the most competitive p-type candidates in the field of transparent electronics.[1] However, the strong compensation effect and air contamination lead to uncontrollable electrical properties.[2,3] As one of the most crucial transparent devices, CuI thin-film transistors (TFTs) face the critical challenge of balancing high performance and environmental stability.Herein, we propose a room-temperature pulsed laser deposition (PLD) process for ambient-stable, high-performance p-type CuI TFTs and circuits. By introducing a buffer layer between 𝛾-CuI film and substrates, the CuI layer exhibits extremely low surface roughness (RMS < 1 nm), and the film thickness can be precisely controlled lower than 5 nm by the number of laser pulses. The free hole carrier concentration can be tuned from 1014 cm-3 to 1019 cm-3 and mobility can reach 25 cm2 V−1 s −1 comparable to that of bulk CuI by controlling the compensation effect from iodine deficiency.[4,5] In addition, a 200-nm-thick amorphous Al2O3 capping layer was deposited *in situ* on the thin CuI film. The concentration of free hole carriers in the covered film decreased by several orders of magnitude and remained stable in the air, enabling long-term device operation under ambient conditions. The optimized TFTs exhibit a field-effect mobility of over 0.5 cm2 V-1 s-1 and a high on/off current ratio of ~104 with good operational stability and reproducibility. This study provides a promising pathway toward ambient-stable transparent p-type field-effect transistors for complementary electronics in combination with n-type metal-oxide devices.

Reference

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