

Title:

Flexible metal oxide thin-film transistors for analog electronics

Abstract:

Creating reliable connections between our physical and the digital worlds is one of the key challenges on the way to efficient Industry 4.0 processes or personalized healthcare solutions. Both requires the unobtrusive collection of data which can be used by advanced computer systems. Consequently, this calls for, a large number of autonomous sensor systems integrated into everyday objects or operated in contact with the human body. Such systems made from sensors and conditioning electronics cannot be bulky and rigid, but must be lightweight, biocompatible and have to adapt to the movement of artificial and organic surfaces. Thin-film devices fabricated on large-area plastic substrates can result in flexible electronic circuits, but the properties of polymeric substrates impose certain limitations such as a limited feature size and temperature resistivity influencing the fabrication and performance of the devices. Therefore, the realization of unobtrusive systems requires the simultaneous optimization of mechanical and electrical device properties.

Here it is presented how low temperature processed amorphous Indium-Gallium-Zinc-Oxide (IGZO) based thin-film transistors (TFTs) can be designed and manufactured on free-standing plastic foils. The electrical DC and AC performance of such devices outperforms many other flexible technologies while the TFTs stay operational even when wrapped around a human hair. Furthermore, it will be discussed how innovative device structures, simulations, and circuit topologies can be used to realize integrated analog circuits such as amplifiers, buffers, or transceivers based on IGZO TFTs. Such circuits are easily customizable and ideally suited for the onsite amplification of signals from flexible sensors. Finally, it will be shown how flexible electronics and sensors are integrated, to demonstrate entirely flexible, front-end conditioned sensor systems for the next generation of wearable and imperceptible electronics.