Circularly Polarized Light Detection using Cellulose Nanocrystals Photonic Dielectrics

P. Grey, S. N. Fernandes, D. Gaspar, R. Martins, E. Fortunato, M. H. Godinho and L. Pereira

CENIMAT/I3N, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa and CEMOP-UNINOVA
Campus da Caparica, 2829-516 Caparica (Portugal)

Cellulose nanocrystal (CNC) have been in the spotlight, owing to properties such as iridescence and selective reflection and transmission of CPL, attributed to the inherent chirality of individual CNCs, which self-assemble into left-handed twisted superstructures. Consequently, LCPL is reflected whereas RCPL is transmitted. In this work we report on the integration of bioinspired CNCs films into transistor devices with distinct sensing properties for left- and right-handed circular polarized light (LCPL and RCPL, respectively). The CNC films with a left-handed internal long-range order are infiltrated with alkali ions to yield highly polarizable photonic solid-state electrolytes capable of LCPL reflection and RCPL transmission. They are employed as gate dielectrics in sputtered amorphous indium-gallium-zinc-oxide (a-IGZO) semiconductor devices. The obtained depletion mode transistors yield low-voltage operation (< 2 V), On-Off ratios of up to 7 orders of magnitude, subthreshold slopes of 77 mV dec-1 and saturation mobilities of 8.3 cm2 V-1 s-1. Combining the photonic character of the CNC films with the light sensible a-IGZO, the devices are capable of discrimination between LCPL and RCPL signals. This type of devices could find application in photonics, emission, conversion or sensing with CPL but also imaging or spintronics.

Corresponding author: Luis Pereira, lmnp@fct.unl.pt