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Editorial: Physical model and applications of high-efficiency electro-optical conversion devices, volume II

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Editorial on the Research Topic
Physical model and applications of high-efficiency electro-optical conversion devices, volume II

The realization of optoelectronic devices is driven by the optimization of their physical models, which determine the properties of the electro-optical conversion, energy harvesting, light-emitting, logic gates, and displays, *etc.* [1] Driven by the above demands, we have organized the present Research Topic and collected ten papers that can be classified into four research directions. This is the second volume on this Research Topic, the first has been published.

The first research direction focuses on electrowetting displays (EWDs) [2] with five papers. An arc multi-electrode pixel structure based on the electric wetting principle was proposed to improve the response speed of pixels in EWDs by Lai et al. They simulated the influence of the arc multipole pixel structure on the response speed by establishing a three-dimensional model. The effect of the driving sequence on oil movement in pixels was analyzed. Similarly, Zhang et al. proposed an EWD structure based on three cholesteric liquid crystal materials. It had an independent PCLC reflection film to improve the reflectivity and gamut width of EWDs. Their experimental results showed that this structure provided a new idea for improving the luminance and color gamut of current EWDs. In addition, the filling of oil and polar liquid would also affect the performance of EWDs. Therefore, Jiang et al. proposed a phase change filling structure to solve the defects of low video response speed and low luminance caused by the filling process. The structure provided a way to effectively shorten the filling and coupling times of the EWD panel, and thus to improve oil's controllability so as to obtain a good response time and aperture ratio. Specifically, designing a new structure could compensate for limitations of EWD devices, enhance its driving performance, and expand its application in the display field. An extensible driving waveform for multiple grayscale colorful EWDs was proposed to realize an 18-bit color dynamic display on an extended display matrix by Zhang et al.. The driving waveform of the color grayscale display was designed by using a grayscale model and a color display model. And then, a large-size display based on a matrix panel was realized by using the extensible driving model. Similarly, an alternating current (AC) driving waveform was proposed to improve the static image display instability and residual phenomenon caused by charge trapping and contact angle hysteresis by Li et al.. A highly integrated EWD system was constructed by using Xilinx field programmable gate array (FPGA). In addition, an asymmetric intermediate frequency AC driving waveform was proposed to eliminate video artifacts. The driving waveform was used to effectively solve the problem of residual and static images to achieve a highly smooth display output and provide a reliable test solution for EWDs.

The second direction contains two papers from Hu et al. In their first paper, they proposed a 10 bit 1 MS/s SAR ADC with one LSB common-mode shift energy efficient switching scheme for image sensor. The ADC design is based on the two sub-capacitor arrays architecture, the common-mode technique, low power dynamic comparator, bootstrap sampling switch and low-power Bit-Slice logic circuit. Simulated in 180 nm CMOS process and 1 MS/s sampling rate, the ADC achieves the 60.06 dB SNDR, the 75.43 dB SFDR and the 10.45 μW power consumption. In their second paper, a 256 × 256 active pixel image sensor array based on a 3-D dual-gate photosensitive thin-film transistor was presented. The pixel pitch, pixel fill factor, photoconductive gain, and the spatial resolution are respectively 50 μm, 63%, 10^2–10^4 and 505 ppi. Such an array is capable of dynamic imaging at a frame rate of 34 Hz.

In the third direction about the Majorana bound states (MBSs) Chi et al., Zhang et al. have studied the spectral function in a quantum dot connected only to one normal metal lead to detect the MBSs, which are formed at the ends of a topological superconductor nanowire and couple to the lead with spin-dependent hybridization strengths. They found that the lead–MBSs interaction induces a bound state characterized by an infinitely high peak in the dot's zero-energy spectral function. The overlap between the two modes of the MBSs turns this bound state into a resonant one, and thus the zero-energy peak is split into three with the height of the central one equaling to that in the absence of lead–MBSs coupling. Sun et al. have studied the Andreev reflection processes in a T-shaped double quantum dots with the central one coupled to the MBSs. They showed that the in-gap state is sensitive to the existence of MBSs, which induce Fano antiresonance in the local density of states at the in-gap state. The differential Andreev conductance also exhibits Fano-type resonance whose tails' directions can be adjusted by the MBSs.

Finally in the fourth research direction, experimental results of Liu et al. showed that the total ionizing dose (TID) irradiation failure of the FPGA under different dose rates has nothing to do with the input voltage parameter exceeding the standard; with the decrease of cobalt source irradiation dose rate, the TID effect failure dose threshold of the FPGA gradually increased. Their theoretical analysis suggests that the oxide charge annealing effect plays a dominant role, and longer irradiation time is beneficial to the oxide charge annealing.

In conclusion, this editorial is devoted to present the latest progress of the Research Topic: Physical Model and Applications of High-Efficiency Electro-Optical Conversion Devices. Our special thanks to all authors of the articles published on this Research Topic for their valuable contributions and the Frontiers in Physics team for the technical assistance with publishing.

Author contributions

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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