Supporting information

Electrophoretic display for IR emissivity modulation and temperature control.

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Figure S 1: Different steps of the photolithography process used to etch the interdigital electrodes of electrophoretic cells.



Figure S 2: Schema of the electrophoretic cell under IR radiations.

Considering the general model, the entire electrophoretic cell can also be considered as a proper object exhibiting its own reflectivity, transmittance, emissivity, and temperature (R_{obj} , t_{obj} , ϵ_{obj} , T_{obj}). In a first approximation, the transmission coefficient of the whole cell can be considered equal to zero (t_{obj} =0), i.e. opaque in the IR. Thus, during observation and temperature measurements performed on the object by an IR-camera, the apparent temperature of the cell as well as its emissivity are estimated using the formula derived from the absorption (abs_{ob}) contribution and luminance (W_{obj}) contribution of Stefan-Boltzmann ($W_{obj} = \sigma \times \epsilon_{obj} \times T_{obj}^4$) and of Kirchhoff ($abs_{obj} = \epsilon_{obj}$) laws, respectively. With $\sigma = 5.669 \times 10^{-8}$ W m⁻² K⁻⁴ the resulting equation gives:

$$\tau_{app\ obj}^{4} = \varepsilon_{obj} \cdot T_{obj}^{4} + (1 - \varepsilon_{obj}) \cdot T_{source}^{4}$$
, and so
$$\varepsilon_{obj} = \frac{T_{app\ obj}^{4} - T_{source}^{4}}{T_{obj}^{4} - T_{source}^{4}}$$

While working, the electrophoretic cell can be placed in two extreme states, corresponding respectively to its most emissive state with $\varepsilon_{obj} = \varepsilon_{em}$ ($\varepsilon_{obj} \rightarrow 1$) or to its most reflective state with $\varepsilon_{obj} = \varepsilon_{ref}$ ($\varepsilon_{obj} \rightarrow 0$) without any change in object's real temperature. At the same time, while operating the electrophoretic cell, the apparent temperature of the object can be modulated using a source temperature (environment). It must be noticed that it is not possible to obtain a temperature contrast only by varying the emissivity of the object. To extend the previous equation, the apparent temperature difference of the object in its emissive state and its reflective state gives the following equations, taking under consideration the contributions of the environment (source) and the states (emissive or reflective) of the device which could not be ignored:

$$T_{app\ obj\ em}^{4} - T_{app\ obj\ em}^{4} - T_{app\ obj\ rf}^{4} = \varepsilon_{em} T_{obj}^{4} + (1 - \varepsilon_{em}) T_{source}^{4} - \varepsilon_{ref} T_{obj}^{4} - (1 - \varepsilon_{ref}) T_{source}^{4}$$
$$\Delta \varepsilon = \varepsilon_{em} - \varepsilon_{ref} \quad \text{and} \quad \Delta T^{4} = \Delta \varepsilon . (T_{obj}^{4} - T_{source}^{4})$$

Where $T_{app\ obj\ em}^{4}$ is the apparent temperature of the object in its emissive state (raised to the fourth power) and $T_{app\ obj\ ref}^{4}$ is the apparent temperature of the object in its reflective state (raised to the fourth power). The larger $\Delta \epsilon$ is, bigger modulation in the apparent temperature will be. Indeed, for a given $\Delta \epsilon$, the more the temperature of the source and the one of the object are different, the greater the range of apparent temperature contrast can be achieved.



Figure S 3: Schema of the electrophoretic cell with contribution of each component to IR radiations.

This schematic representation represents the characterization of each of the three layers in the device and allows to study their unitary contribution to the variations in emissivity which will occur during cell working time.



Figure S 4: STEM image of ZnO nanocrystals.



Figure S5 : (a) Absorbance of aluminum at 396.2 nm and (b) of zinc at 307.6 nm measured by electrothermal atomic absorption spectroscopy as a function of concentration of the elements.



Figure S6: Tested charge controller agent (CCA) for the electrophoretic ink formulation



Figure S7: ζ-potential versus charge controller agent (CCA) in the formulated electrophoretic ink with 0.8 mg/mL of AZO and Span 80 (blue), CTAB (green), SDS (red) or AOT (black).