Optically variable inks

In their article "The black powder behind battery power" (Physics Today, September 2024, page 26), Jeffrey Richards and Julie Hipp discuss how the electrodes for lithium-ion batteries are created by coating metal foils with a complex slurry of conductive compounds, electrochemically active materials, polymers, and other components. They describe how the microstructure of carbon black, the most-used conductive additive, depends on the shear applied during the coating process. That reminded me of the story behind the rise of optically variable inks (OVIs), also known as color-shifting inks.

At the end of the last century, fast advances in color printing and copying led to increased risks of counterfeit currency. To combat counterfeiting, countries began using OVIs on their money. The color of an OVI depends on the angle at which it's viewed.

A printing ink generally consists of a pigment, which determines the optical properties of the final image, dispersed in a liquid carrier and mixed with additives to facilitate drying. A final step in ink preparation is kneading the mixture to the correct viscosity. In an OVI, the pigment is formed by depositing interference layers onto a substrate and then crushing the substrate into small platelets. The delicate balance between the OVI's optical performance—which depends on the size and alignment of the platelets—and the required viscosity created through kneading has been established by trial and error.

The neutron-scattering techniques that Richards and Hipp describe would certainly reduce the trial and error today and at the same time help establish and make understood the critical parameters for the production process of OVIs.

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OPTICALLY VARIABLE INKS, also known as color-shifting inks, are used on many currencies around the world. (Photo by iStock.com/mirzavis.)

Open access for reading or closed access for publishing?

What a marvel open access has become! Sparkling and progressive, it allows everyone access to scientific literature—provided, of course, that scientists are ready to pay dearly for the privilege of sharing their work with the world. The noble goal of disseminating knowledge widely has found an equally noble price tag that has turned many scientists' dreams of open sharing into a harsh reminder of their financial limitations.

Consider the researcher from a country with limited funding. How fortunate they are to find that their esteemed work can be shared freely—if only they can muster a few thousand dollars in fees. And those hoping for a waiver? They get the delight of navigating convoluted processes that often result in outright rejection or significant delays. And although some publishers still offer reasonable policies, others cling to a strict fee schedule and have adopted an unyielding approach that favors revenue over global accessibility.

Publishers need to cover costs, of course. But the shift from pay-for-reading to pay-for-publishing risks broadening the existing divide in scientific publishing and further isolating researchers from underfunded regions.

If open access is to benefit the entire scientific community, it surely requires measures that promote equity and transparency. May this glimmering model one day be no longer a roadblock but instead a true bridge.

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