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Optical Properties versus Compositional & Structural Features of Dried Ink Thin Films

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The water-based inks with polymeric latex particles used in printing technology deliver prints of superior quality at a low cost and environmental friendly. Via ink formulation and drying processes, the inkjet prints are characterized by a wide color gamut, intense gloss with tonal graduations and excellent mechanical properties.

Our study delves into enhancing the optical performance of these inks and printing processes by examining how light interacts with the printed porous surface. The ink's composition features pigments and polymeric beads randomly dispersed with interparticle spaces or fissures. Utilizing High-Resolution SEM imaging, we scrutinize the structure and local makeup of the ink layers post-printing, while VIS spectroscopy aids in assessing their optical attributes.

We employed ray tracing to construct an optical model for colored prints, aiming to forecast the reflected optical spectrum from prints possessing specific porous structures, determined by the spatial arrangement of latex, pigments, and voids/cracks. To ensure accuracy, the model's parameters align with those of a VIS spectrophotometer, maintaining consistent light spectra and angles.

Our results demonstrate the reliability of ray tracing, validated by experimental data, particularly for monochromatic layers on coated substrates. By integrating the print's structure and the optical characteristics of its constituents, we achieved a harmonious match between empirical and modeled outcomes.

Concluding our research, we conducted sensitivity analyses on color coordinates (L, *a*, b*), examining variables like layer thickness, pigment concentration, coverage, and ray count. This exploration offers insights into the intricate interplay between light and porous ink layers, advancing our understanding of their optical behavior.

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