

Spatially and Time-Resolved MRI Studies on the Penetration of Inkjet Inks in Printing Substrates

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Thanks to technical developments, inkjet printing is a good alternative to conventional printing technologies for industrial applications (for example offset print). Impact of an ink drop on the paper, its distribution on the surface and its absorption and penetration are crucial for production efficiency, product quality and energy consumption. Due to its non-invasive and non-destructive operation, Magnetic Resonance Imaging (MRI) was applied to monitor the progress of ink penetration via spatially and time-resolved ¹H measurements [1, 2].

1D-MRI measurements were carried out at an ¹H Larmor frequency of 200 MHz on an in-situ printing experiment with a time resolution in the order of seconds: A paper disk was placed on a 3D-printed carrier in a 5 mm NMR tube and a defined ink volume was applied to the paper via a hose (Fig. 1). Thus, the penetration of the ink along z was measured time-resolved to quantify the absorption behavior (Fig. 2).

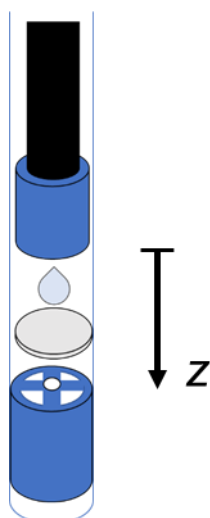


Fig. 1: Experimental setup in a 5 mm NMR tube with paper disk, carrier (blue) and an ink drop.

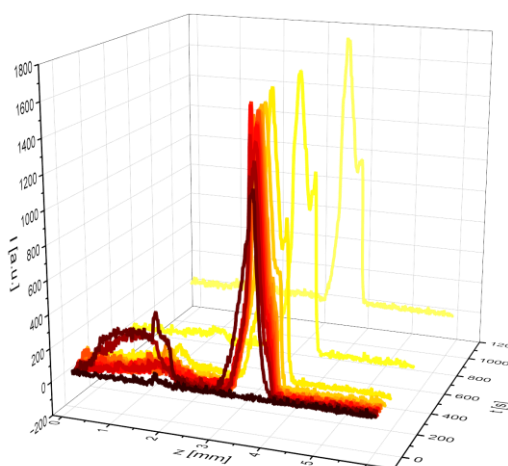


Fig. 2: Signal intensity profiles along z as a function of the experiment time. $t = 0$ s corresponds to the time at which the drop is added to the paper surface.

In order to investigate the effects of different inks and substrates on ink penetration, measurements were carried out on various material combinations. In addition, data processing was investigated in order to maximize the knowledge gained.

References: [1] S. Schuhmann und G. Guthausen, *NMR-Messmethoden: Produkt- und Prozesscharakterisierung*, Chem. unserer Zeit, 55, 236, **2021**.

[2] R. J. K. Nicasy, H. P. Huinink, S. J. F. Erich, O. C. G. Adan und N. Tomozeiu, *Ultra Fast Imaging NMR method for measuring fast transport processes in thin porous media*, Magnetic Resonance Imaging, 103, 61, **2023**.