

SEQUENCE OF ELECTRO-PHOTOGRAPHIC PRINTING AND BALLPOINT PEN WRITING

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ABSTRACT: Electro-photographic copiers and printers randomly spread small toner-particles all over the paper, independent from applied writings. The appearance of toner-particles is different, if they are overwritten by ballpoint pen ink or vice versa. Therefore, it is possible to determine the sequence of writing and printing in the absence of an actual line-crossing.

KEY WORDS: Sequence of writing and printing; Toner-particles; Ballpoint pen inks; Microscopy.

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EQUIPMENT

- Research microscope Leica DM-RXE,
- photo-adapter Vario Orthomat 2,
- objective PL Fluotar 100 × / 0.90 D.

PROCEDURE

Several text-samples were prepared with blue and black ballpoint pen ink onto two sheets of DIN A4-paper. Afterwards one paper was used in a laser-printer HP LaserJet IIIp and the other one in a photocopier Canon NP-4050 for application of toner-particles. Subsequently both sheets were again written on with the above mentioned blue and black ballpoint pen ink. Toner-particles placed in the ballpoint pen ink-lines were examined by microscopy.

RESULTS

Separately placed toner-particles overwritten by ballpoint pen ink show a characteristic glossy and coloured surface, probably caused by ballpoint

pen ink-deposits. In addition, a certain amount of toner-particles appear flattened and damaged, possibly caused by the mechanical force of the pen-tip. Both observations indicate that the toner-particles are overwritten by ballpoint pen ink. In some cases flattened particles are found, although the toner was applied after the ballpoint pen ink. Therefore, flattened toner-particles without a glossy surface are not indicative of the application of ballpoint pen writing after the printing.

Fig. 1. Toner-particle above black ballpoint pen ink.
Magnification: 1000 ×; field diaphragm: off; filter: BG 20; polariser ICR: off; aperture diaphragm: 1–2; analyser IC/P: off; decentration: 2; exposure time [1/100 s]: 201.

Fig. 2. Toner-particle above blue ballpoint pen ink.
Magnification: 1000 ×; field diaphragm: off; filter: no; polariser ICR: off; aperture diaphragm: 2; analyser IC/P: on; decentration: 2; exposure time [1/100 s]: 62.

Fig. 3. Black ballpoint pen ink above toner-particle.
Magnification: 1000 ×; field diaphragm: off; filter: BG 20; polariser ICR: off; aperture diaphragm: 5; analyser IC/P: off; decentration: 2; exposure time [1/100 s]: 46.

Fig. 4. Blue ballpoint pen ink above toner-particle.
Magnification: 1000 ×; field diaphragm: off; filter: BG 20; polariser ICR: off; aperture diaphragm: 2; analyser IC/P: off; decentration: 2; exposure time [1/100 s]: 32.