Magnetic field assisted micro contact printing: a new concept of fully automated and calibrated process

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Micro contact printing (μ-CP) [1],[2], is a simple and cost-efficient technology well established worldwide. Interestingly, though its wide application range, there is no standardized or calibrated system permitting to transfer scientific research to industrial applications. Indeed, one of the critical points in μCP is the control of the force applied on the stamp during the printing step. The technologies developed are always based on a mechanical force (air[3] or hydraulic[4] pressure or mechanical devices [5],[6]. The drawback of this choice is that the stamp geometry has to be adapted to the mechanical system.

In this work, we propose a new concept: the magnetic field assisted micro contact printing. For that, we integrated on the upper side of a stamp a quantity of iron powder (25% weight). The stamp became sensitive to a magnetic field. So, changing the magnetic field strength permits to adjust the force applied. Thanks to magnetic force simulations, corroborated by experimental measurements (figure .1), we found that the force can be tuned by the distance between the stamp and the magnet (from 0 to 30 mm).

In addition to the tuned application force, our design enables to transport the stamp during the process, leading to a fully automated process, ready for industrial applications. Our system, INNOSTAMP40 is thus fully automated and calibrated for better standardization of the technology. This equipment is composed of different modules (figure 2) which correspond to the elementary steps of the μCP process: loading, inking, alignment, drying, stamping, cleaning and unloading zone.

We demonstrated the genericity of this technique on figure 3. We can use stamp geometry from 1cm² to 19cm² (glass slide format) with normal or macrostamp formats[7] without any mechanical adaptation. It shows the adequacy between the INNOSTAMP40 and biological applications (biochip, microarray, lab-on-chip …) that need multiplexing.

In conclusion, we have demonstrated that the concept of magnetic stamp permits to create a bridge between the lab experiment and its industrial applications.

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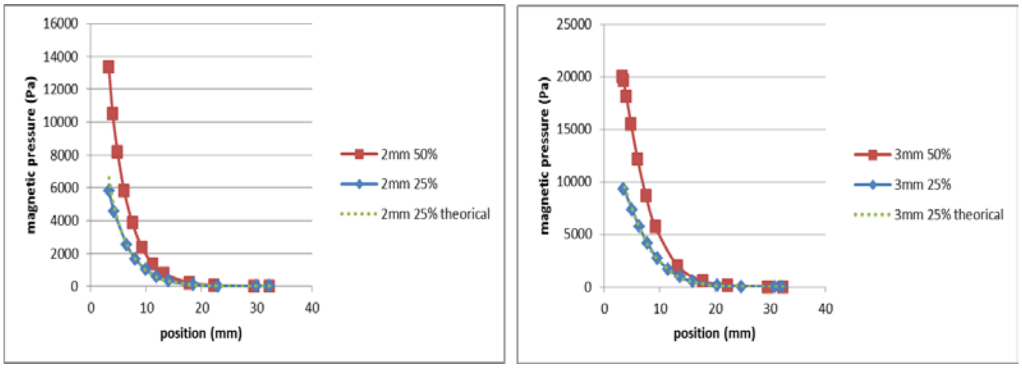

Figure 1 : Evolution of the magnetic pressure as a function of the distance between the stamp and the magnets for two iron powder concentrations: 25% and 50% weight and for two stamp thicknesses: 2mm and 3 mm.

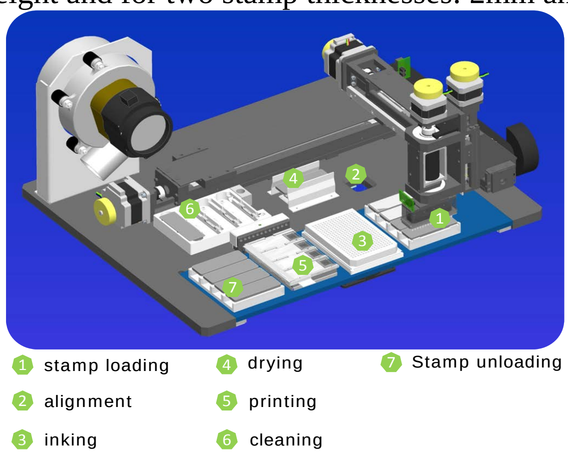

Figure 2. Schematic view of the automate INNOSTAMP40

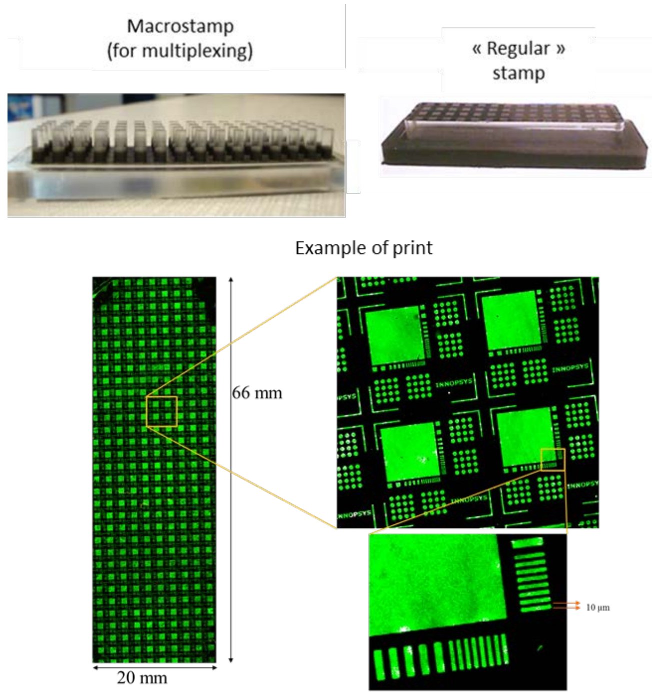

Figure 3 : Pictures of “regular” stamp and macrostamp, and an example of print (Cy3 fluorescent dye).