Magnetic Reversible Sealing of PDMS Microfluidic Devices
Matteo Moretti¹, Nasser Sadr¹, Francesco Piraino², Alberto Redaelli², Marco Rasponi²
Corresponding Author: Marco.Rasponi@polimi.it
¹IRCCS Galeazzi Orthopedic Institute, Milan, Italy and ²Politecnico di Milano, Milan, Italy

Introduction
Microfluidic devices are traditionally assembled through irreversible sealing of the surfaces. Current potential of these devices is however sometimes limited by this constraint. Several applications, including complex cell patterning and surface functionalization as well as insertion and removal of macroscopic, solid or non-injectable samples and analysis techniques not achievable within the microfluidic devices would benefit from reversible bonding capabilities. In this work, we present the use of magnetism applied to microfluidic channels to achieve reversible sealing.

Materials and Methods
PDMS was spun at a thickness of 500µm on a silicon wafer to generate a Y-shaped fluidic structure (200µm and 75µm cross-section channels). An additional 3mm thick mold was produced using a CNC milling machine, replicating a Y-shaped, 600µm wide, protrusion. Additional PDMS was cast on this second mold, and surrounded by iron powder/PDMS mixture. The two layers were then aligned and bonded together. The microfluidic device was coupled with an histology glass slide and kept together applying magnets below the glass (Fig. 1). Human primary chondrocytes and HeLa cells were perfusion seeded and cultured into the devices.

Results
Reversible sealing of the microfluidic devices was achieved. Importantly, microchannels remained sealed also at both the Y connection and where the channel branches flow parallel. Magnetic sealing was tested by application of confined hydrostatic pressurization of the channels up to 50 kPa and dynamic flow-through pressurization up to 122 kPa. Cells were successfully cultured to follow the channel pattern (Fig. 2). Exploiting the reversible sealing, the glass slide was then separated thus obtaining a traditional histological staining of the cells.

Discussion and Conclusions
To our knowledge this is the first magnetic reversible sealing applied to PDMS microfluidic devices, providing sealing strength comparable to previously reported macro-fluidic, bar magnet based devices [1]. The proposed technology can be directly applied to more complex microfluidic designs, without requiring standard culture protocols variations. Magnetic reversible sealing provides an enabling technology allowing to broaden the field of application of microfluidics.

References

Acknowledgments This project is supported by partial funding from Cariplo Foundation (Italy).

Disclosures Authors have nothing to disclose.