Deliverable 11.6

ML² – Multi Layer Micro Lab

Demonstration of the ML² Tool box

1. Introduction

The overall idea of the ML² tool box, the realisation by implementing a data base, the chip design and a set of standard functional elements (components) have been introduced in D 2.1.

This deliverable will demonstrate the ML² tool box as a pool of functional elements (components) for the design of lab-on -a-chip systems. First it is shown how microfluidic, optical or electric functions can be extracted from existing lab-on-a-chip solutions. Second it is given how the information are implemented in the tool box structure and third how one can make use of the information for new chip designs.

The deliverable is a working document. The specifications of the different components from Demo I – III are still part of an on-going design process. The microfluidic structures shown in this document have been provided by Dolomite Microfluidics. The design has already been proven in practice. Chips with this structures, but made of glass, are commercially available.

2. Chip designs

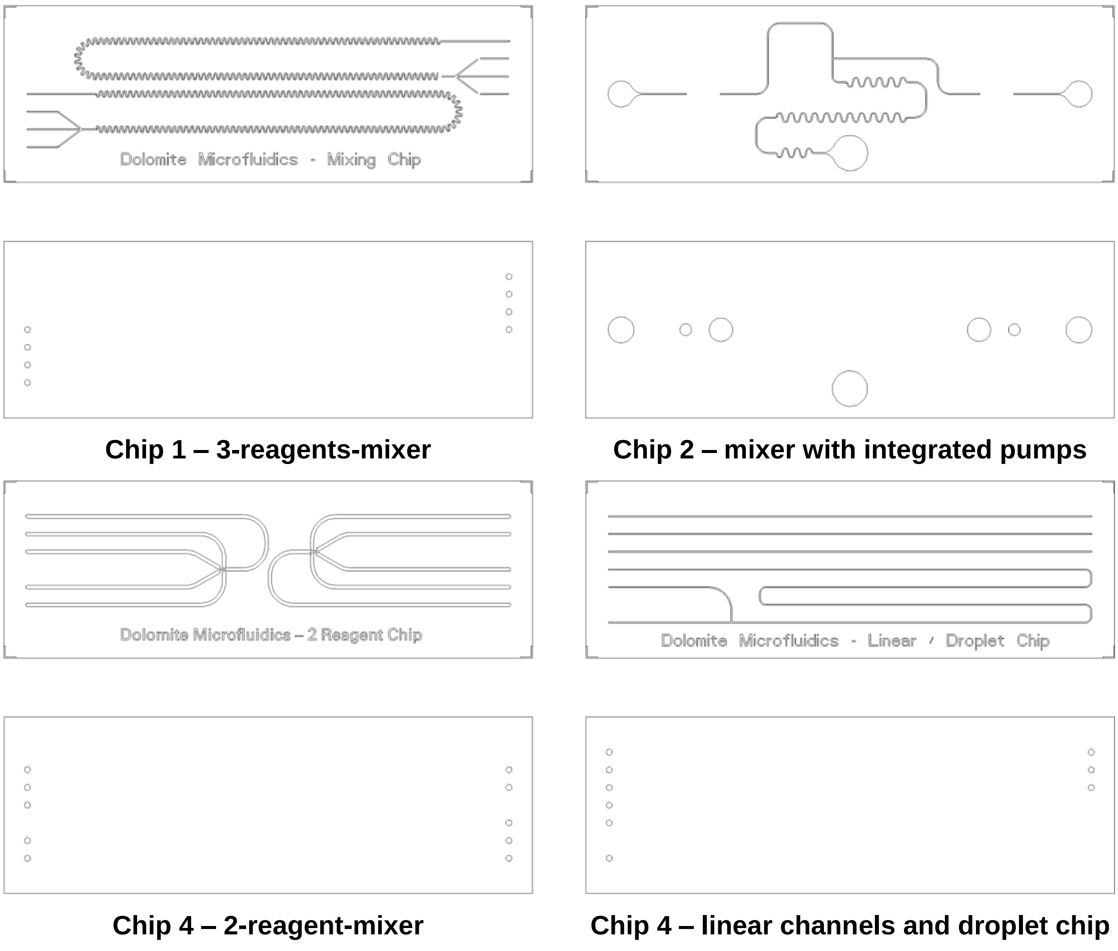


Figure 1: Different microfluidic chip designs by Dolomite Microfluidics

Figure 1 shows four different chip designs of commercially available Dolomite lab-on-a-chip systems. The upper image is the bottom part of a chip containing the microfluidic channels and chambers. In ML² multilayer structure these will be polymer substrates (e.g. PMMA, PET or COC) coated with an UV curable lacquer. The lacquer contains the embossed shapes. The lower image is the top part of each chip. It contains fluidic vertical interconnect accesses. These are the in- and outlets for the different reagents.

Chip 1 contains two mixing structures with three inlets and one outlet each. As all the other chips the in- and outlets of the chip are arranged to fit in a Dolomite Multiflux® connector.

Chip 2 is a mixing chip as well. Two reagents can be pumped from separate reservoirs respectively from inlets by on chip pumps. The reagents are pushed through meandric mixing channels into an outlet chamber.

Chip 3 consists of two fluidic systems as well. The 2 reagent chip can be used for mixing by dosing droplets from different channels merging in one outlet channel. These methods allow extremely precise mixing because of the precise dosing of micro droplets.

Chip 4 is a droplet chip, too. Besides the droplet channels it contains three straight channels just for forwarding substances without any particular process steps.

3. Derivation of functional elements (components)

Figure 2 shows the functional elements (C1 – C4) which can be derived from the setup of Chip 1. It's the infeed for three different fluids (C1) and the outfeed (C2) of the mixed product. Their geometry and position is compatible to Dolotmite's Multiflux® connector. Further the merging triangle structure and the mixer can be identified as separate functional elements.

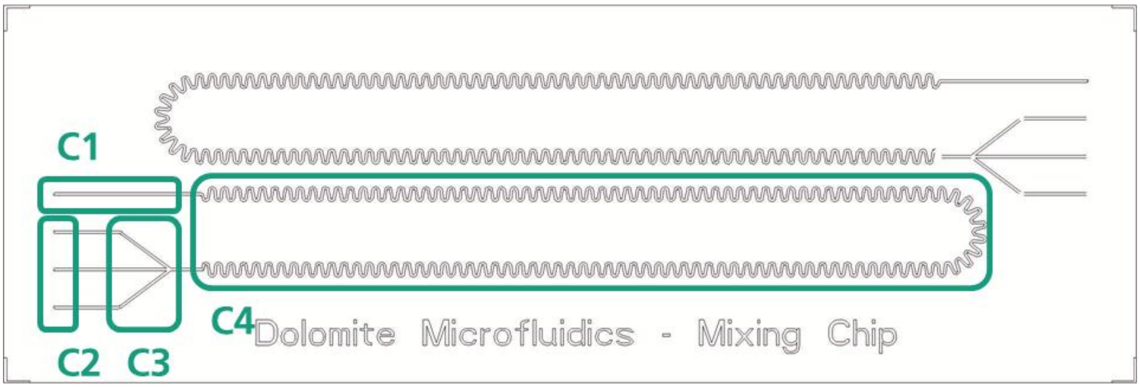
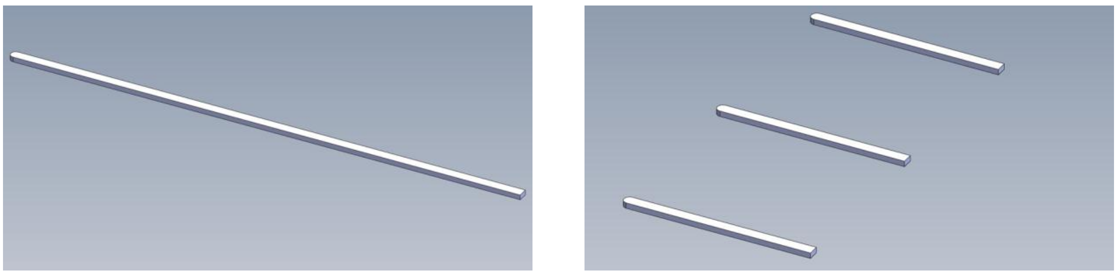
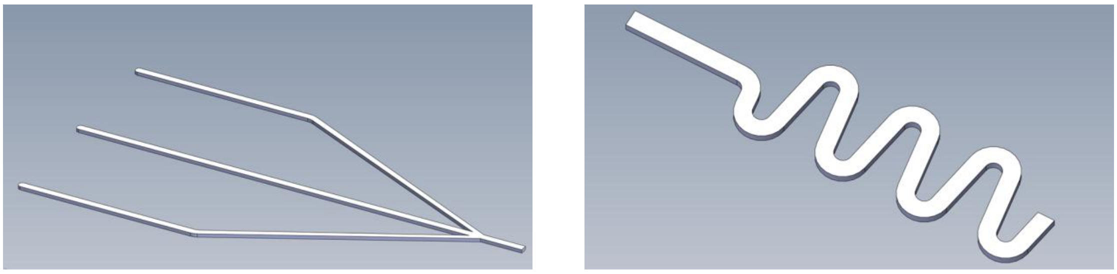


Figure 2: Functional elements components of Chip 1 (bottom side)

The four named components are redesigned as single elements in SolidWorks CAD modelling software. Channel depth, width, length or the number of turns for the mixer can be configured as parameters of the element drawing. Basis for the configuration of the separated functional elements is a excel sheet with all relevant parameters.



C1 – Outlet channel **C2 – Inlet channels**



C3 – 3 reagent infeed **C4 – mixer structure**

Figure 3: Extracted tool box components

4. Tool Box architecture

The functional elements are archived in the ML² tool box. This consists of three major branches shown in Figure 4. They are Materials, Functions and Components. Each component can be described by its function which is of optical, electronic or microfluidic origin. Information about the functionality depending on shape etc. can be stored in the CAD models mention above. Closely connected to the functions are the used materials which can be divided in Operating ressources and Materials.

With the branch Components the user can get general information about the performance and the setup of a separate component. The information are subdivided into the materials and functions and give a condens summary of the component in particular. If detailed descriptions of the operating ressources for example are required the user can use links to the certain categories. CAD models and parameter lists are given with links for each component. A user is able to choose from the functional elements already characterized and set up a new lab-on-a-chip design by combining them.

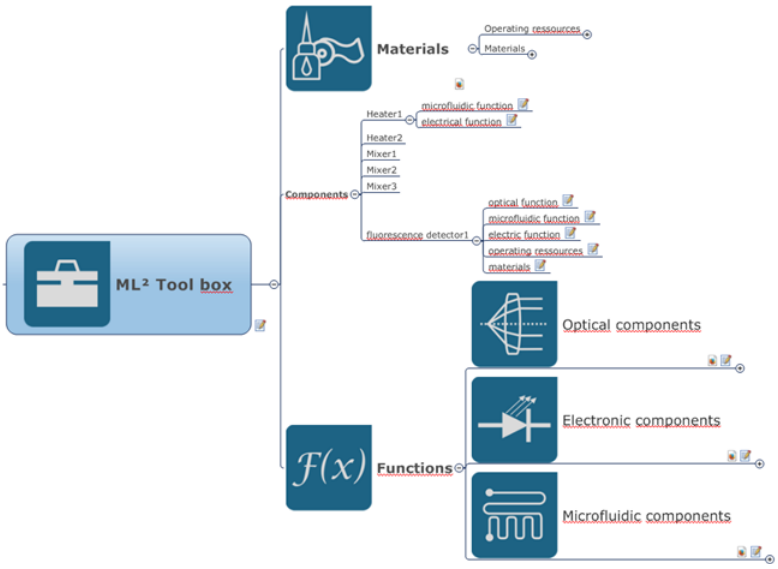


Figure 4: Tool box architecture