Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary data:

1. Cross section of the optical housing

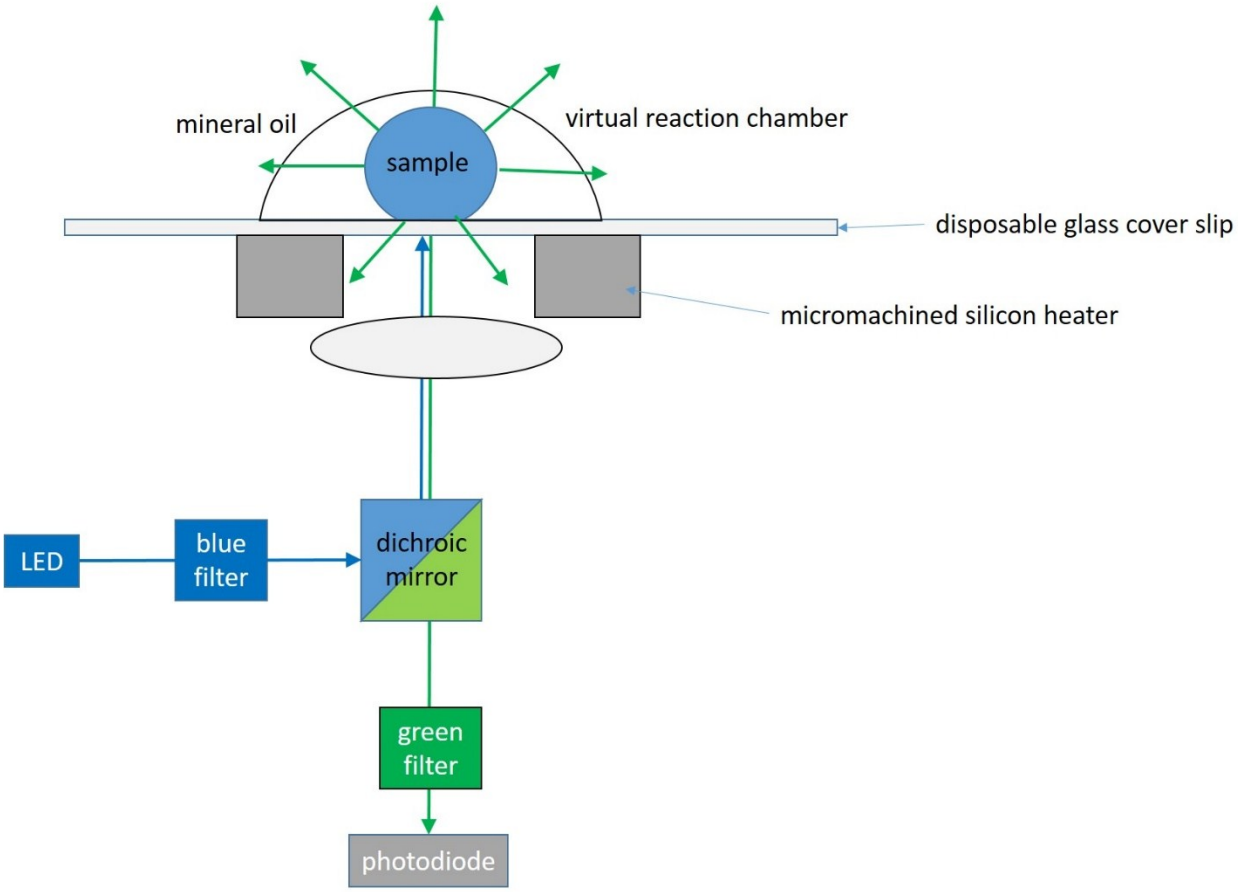

Figure 1: Cross section schematic of the handheld PCR system illustrating the optical path. Light emanating from the LEDs is filtered, then deflected by a dichroic mirror, and focused via lenses onto the VRC. A disposable glass slide separates the VRC from the micromachined silicon chip. The emitted fluorescence is collimated (using the same set of lenses), then passes through the dichroic mirror and a green filter prior to being captured by the photodiode.

2. Schematic of the PCR system

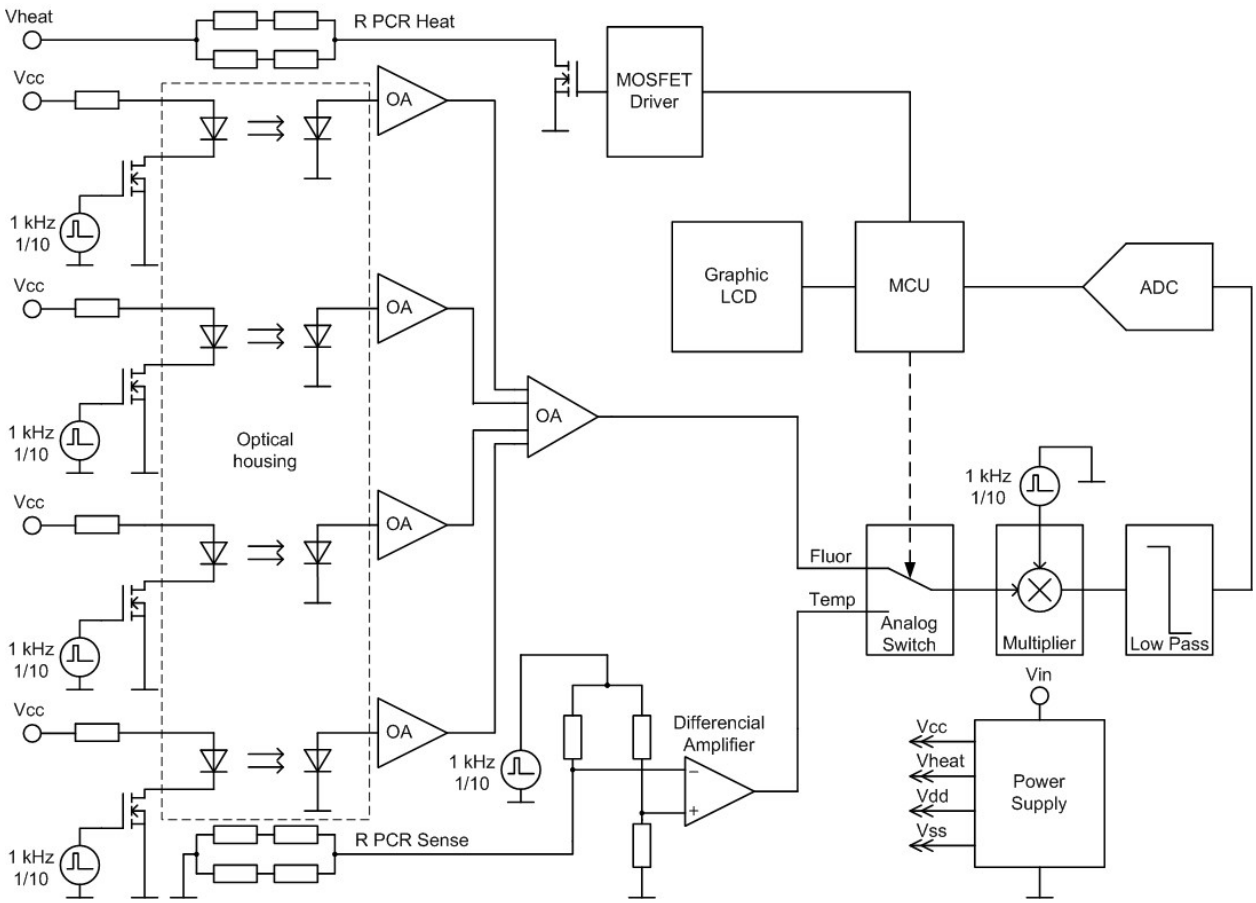

Figure 2: PCR electrical schematic showing four blocks of the fluorescent system inside the optical housing followed by transconductance operation amplifiers, by a generic amplifier and a Wheatstone bridge for temperature monitoring. The analog selector was used for further processing either the fluorescence or the temperature signals by the microcomputer (MCU) via an analog to digital converter (ADC). The processor also controls the dissipated Joule heat within the PCR chip and its temperature via a MOSFET driver.

3. List of components: Table 1

category	type	parameters	number
electrical	Square wave generator	Frequency: 1 kHz duty cycle: 10 %	6
	Power MOSFET	N-channel MOSFET with $R_{DS(on)}$ = 170 mΩ	4
	Power MOSFET	N-channel MOSFET with $R_{DS(on)}$ = 30 mΩ	1
	LED	Wavelength: 470 nm Luminous intensity: 7.2 – 12 cd Diameter: 5 mm	4
	photodiode	7.4 mm^2	4
	Operation amplifier	diFET with bias current < 100 fA	4
	Operation amplifier	Noise < 15 nV/√Hz @ 1 kHz	1
	Differential amplifier	Noise < 8 nV/√Hz @ 1 kHz	1
	Analog switch/analog to digital converter	16 bit resolution, 2 selectable differential inputs	1
	Analog multiplier	4-quadrant analog multiplier	1
	Low pass filter	2 Hz cut off	1
	MCU	16 bit microprocessor	1
	Graphic display	84 × 42 pixels	1
	Switched power supply	Generating DC voltages: +5V, ±12V, +18V	1
thermomechanical	Micromachined silicon chip	Custom layout, integrated with thin film heater and RTD sensor	1
optical	Optical housing	Made by CNC	1
	Low pass filter	490 nm	2
	Dichroic mirror	495 nm	2
	Long pass filter	510 nm	1
	Lens	Diameter: 6.35 mm N.A.: 0.68 Focal length: 3.1 mm	4

4. PCR chip layout

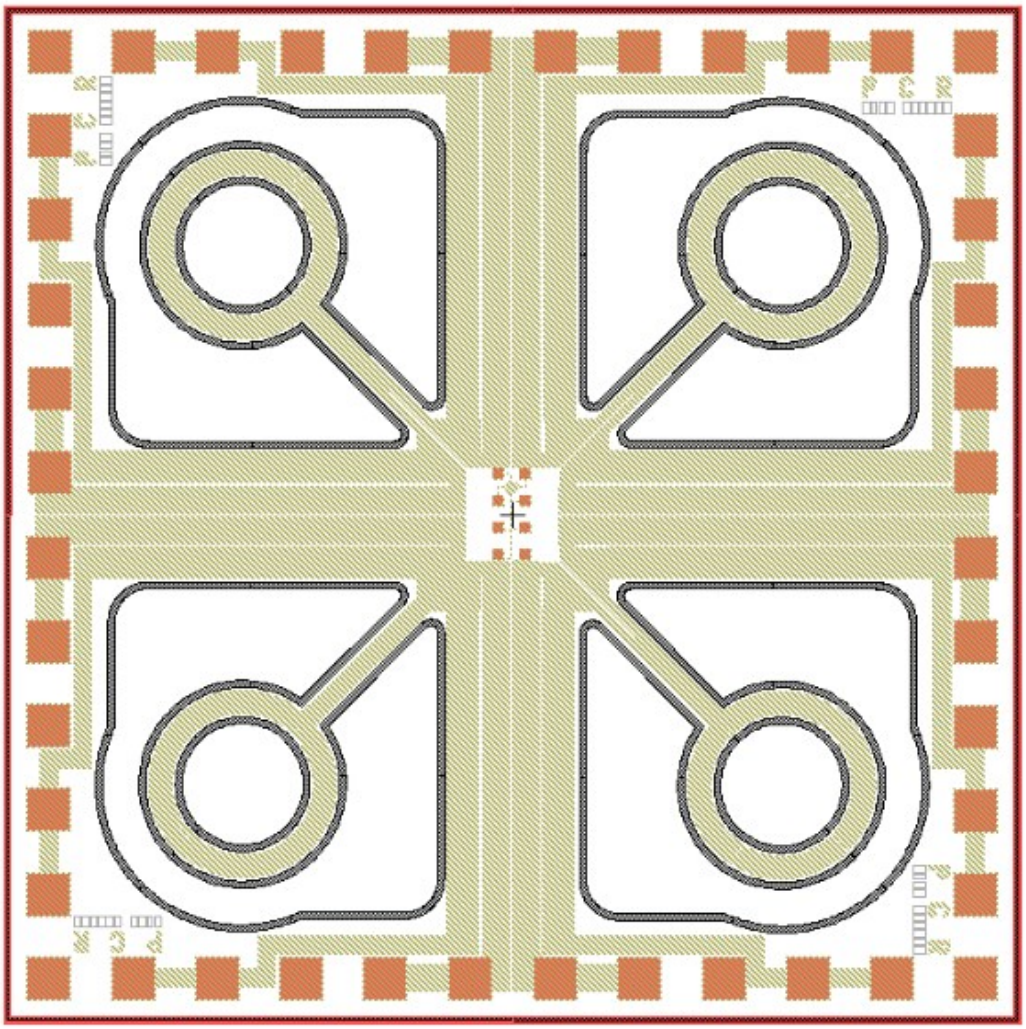

Figure 3 Layout of the PCR chip. The chip is square size with side of ≈ 15 mm. The distance between heater centers is ≈ 8mm.

5. PCR chip fabrication process
    a. Starting substrate silicon wafers with diameter of ≈ 100 mm
    b. SiO_2 deposition by plasma enhanced chemical vapor deposition (PECVD) process with thickness of ≈ 0.5 μm
    c. Au/Cr deposition by sputtering with thickness of ≈ 200 nm and ≈ 5 nm for Au and Cr, respectively
    d. Contact lithography (Au/Cr patterning)
        i. Positive photoresist (PR) spincoating with PR thickness between 1 and 2 μm
        ii. PR pre-bake
        iii. Soft contact exposure
        iv. Postbake
        v. PR developing
        vi. Wafer spin drying
    e. Au/Cr patterning by ion milling with secondary ion mass spectroscopy (SIMS) end point detection
    f. PR removal by acetone and 2-n propyl alcohol or stripper
    g. SiO_2 deposition by plasma enhanced chemical vapor deposition (PECVD) process with thickness of ≈ 0.5 μm.
    h. Contact lithography (bond pads opening)
        i. PR spincoating with PR thickness between 1 μm and 2 μm
        ii. PR pre-bake
        iii. Soft contact exposure
        iv. Postbake
        v. PR developing
        vi. Wafer spin drying
    i. SiO_2 etching by ≈ 40 % NH_4F and ≈ 49 % HF in ratio of ≈ 7 : 1 (BOE 7:1)
    j. PR removal by acetone and 2-n propyl alcohol or stripper
    k. Contact lithography (silicon etching)
        i. PR spincoating with PR thickness between 8 and 12 μm
        ii. PR pre-bake
        iii. Soft contact exposure
        iv. PR developing
        v. Postbake
        vi. Wafer spin drying
    l. SiO_2 etching by BOE 7:1
    m. Silicon etching by Bosch process through silicon water
    n. PR removal by acetone and 2-n propyl alcohol or stripper
    o. Chips drying by N_2
    p. Soldering chips to the printed circuit boards