Lab-on-a-Chip solutions designed for being operated on standard laboratory instruments

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Introduction

We report lab-on-a-chip solutions that can be operated on standard laboratory instruments. Although disposable lab-chips can be produced at low cost, market penetration can be hindered by initial invests for instrumentation. Therefore, we upgrade standard laboratory instruments by microfluidic disposables for process automation. This could significantly increase the acceptance of lab-chips. We present:

1. Microfluidic disks for DNA pre-amplification, aliquoting and real-time PCR, operated on a Qiagen thermocycler with < 10 copy sensitivity.
2. Fully automated hematocrit measurement in a DVD ROM drive from <10 µL of whole blood.

Methods and Results

DNA analysis is a very attractive field for µTAS. We developed microfluidic foil disks that can be processed in a standard laboratory instrument for real-time PCR (Rotor-Gene, Corbett-Research, acquired by Qiagen). In a first application example, we developed a microfluidic structure, which allows pre-amplification of a 20 µL PCR volume, mixing with 160 µL dilution buffer, aliquoting into 14 sub-volumes and subsequent individual real-time PCR. As little as 7 DNA copies in the PCR volume could be detected. Novel approaches also allow for isothermal amplification and detection of DNA. We established an integrated microfluidic assay based on the novel RPA technology, which allows detection of the antibiotic resistance gene mecA of *Staphylococcus aureus* from <20 starting copies in <15 minutes at a constant temperature of 37 °C.
We furthermore realized a fully automated hematocrit test operated in a standard DVD drive with modified firmware. After insertion of 8-10 µL blood, the sedimentation, readout and result reporting are fully automated by the device.

Conclusion

We demonstrated our latest results in multiplex DNA amplification and detection and hematocrit measurement in standard instruments. This constitutes a significant progress beyond the state-of-the-art in terms of instrument costs what might significantly support the breakthrough of lab-chips in everyday lab situations.