Integrated microfluidic system for bacterial detection

Proposers

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Introduction

Increasing bacterial resistance to antibiotics has the potential of becoming a major health issue in the near future. Health systems all over the world are working in several aspects of this problem, from the strict control and reduction of the prescription of antibiotics to a control of the infection propagation in hospital environments. Existing techniques – such as cell culture on plates or nucleic acid detection - do not present the necessary combined conditions of sensitivity, specificity, time of analysis and potential cost. The objective of this project is to develop an integrated microfluidic system for detection of specific bacteria (MRSA and CRE) in swabs from patients waiting for hospital admission. The device should allow results to be obtained in 15 minutes (max. 30 minutes) and have a potential cost of € 5-10 (ma. € 20). This project is within collaboration with a hospital in the Lisbon region.

Partner 1

The Thin-Film MEMS and BioMEMS group at INESC MN has extensive experience developing integrated microfluidic systems for biosensing. Particular recent focus has been on integrated sample preparation modules, optical detection, and the use of nanoporous microbeads.

Partner 2

INL is an organization focused on the development of nanotechnologies for the medical, environmental, and electronics area. The research group has biosensor-core know-how, and have been developing assays using different biomarkers (e.g. proteins, DNA, virus). Moreover, in past, the team developed strategies for the detection of bacteria in a viable but nonculturable (VBNC) state which knowledge can benefit the proposed project.

Project outline/goal

The integrated microfluidic device will integrate three functions: (i) nucleic acid extraction; (ii) nucleic acid amplification; and (iii) nucleic acid detection. In a first phase, each of these functions will be separately optimized in specific microfluidic chips. We expect to achieve nucleic acid extraction using nanoporous microbeads, nucleic acid amplification using an isothermal amplification such as RCA (rolling circle amplification), and optical detection of the amplification products by DNA hybridization. In a second phase, the different functions will be integrated in a single chip. The system will be developed with model bacteria. After preliminary development, real samples results from buccal or rectal swabs will be used.

Student profile

Profile sought: preference, but not limited, to students with a background in Biomedical Engineering, Biological Engineering or Biotechnology with an interest in exploring complex microfluidic systems for practical applications. Experience in Micro and Nanofabrication would be helpful.