Detection of microbes using flowing lyotropic liquid crystals

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Microbial contamination of food, water and even air supply is a permanent threat against the health of humans and livestock. This threat is particularly serious in contexts such as hospitals (Legionella contamination of air-conditioning) and in extreme situations, such as those met in the third world and in natural crisis situations where water contamination is one of the most serious risks to human wellbeing.

Lyotropic liquid crystals (LLC) have been employed in the detection of microbes in hydrophilic solutions since 2006 [1]. Micrometre-size cells or agglomerates disrupt the otherwise ordered LLC structure. Due to the long range viscoelastic interactions between LLC molecules or structures the micrometre size disruption may be amplified several tens of times.

Recently we have shown [2] that the amplification factor can be increased by a factor of at least 10 with respect to what has been achieved elsewhere by applying a slight flow in the LLC. Hereby a total amplification factor exceeding 100× is achieved, making it possible to detect disturbances caused by microbes with the naked eye. The promise of this sensor is that bacterial detection may become as simple as the well-known pregnancy test, although at a cheaper unit price, and with a lot more false positive.

This presentation will include the latest results of the sensor based on flowing lyotropic liquid crystal alignment disruption. The presentation will include details of the design of liquid crystal cell, of the fluidic chip in which the cell is mounted as well as the final chip reader, which has been designed for the recording of the results. Finally we will present the performance of the sensor both with simulated (silica spheres) and real biological targets.

[1] Helfinstine SL, Lavrentovich OD, Woolverton CJ, "Lyotropic liquid crystal as a real-time detector of microbial immune complexes" *Lett. Applied Microbiol.* **43** 27–32 (2006)

[2] Geday MA, Otón E, Escolano JM, Otón JM, Quintana X, "Method for amplifying the detection of targets in an aligned liquid crystal matrix", Patent WO 2015193525, (2015)

Acknowledgements: This work has been supported by Spanish Government RETOS Program grant no. TEC2013-47342-C2-R, the R&D Program SINFOTON S2013/MIT-2790 of the Comunidad de Madrid, and the European EU-FP7 project Raptadiag Grant Agreement No: HEALTH F3-2012-304814