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Abstract

Efficient Development of Microfluidic Solutions for Bioanalytical "Point-of-Use" Testing towards High-Technology-Readiness Levels—A Platform-Based Design-for-Manufacture Approach †

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Integrated microfluidic technologies have demonstrated significant benefits for a range of applications, mostly in the context of decentralised bioanalytical multiparameter testing at the point of use with primary applications in healthcare, pharma, veterinary medicine, agrifood and life-science research as well as monitoring of the environment, infrastructures and industrial processes. For efficient development, FPC@DCU [1], the Fraunhofer Project Centre for Embedded Bioanalytical Systems at Dublin City University—a joint initiative by Science Foundation Ireland (SFI) and Fraunhofer-Gesellschaft, pursues a coherent, design-for-manufacture (DfM) themed platform approach [2]; new, microfluidics-enabled "sample-to-answer" solutions are generated from a common library of geometrically parametrized fluidic elements for flow control, e.g., valves and routers, for coordinating sequential and parallelized liquid handling protocols comprising of mixing, metering, aliquoting, reagent storage and particle removal function. The impact of manufacturing tolerances and artefacts on functionality is considered along all stages of scale-up, ranging from prototyping by ultraprecision milling to tooling, polymer replication (e.g., by injection molding), biofunctionalization and automated assembly of multi-component systems. The DfM paradigm thus assures seamless scale-up from prototyping to pilot series for fluidic design optimization and bioassay development and eventually larger-scale production, thus substantially supporting regulatory approval and significantly de-risking commercial product development. FPC@DCU's platform-based, DfM-guided strategy to reach high technology-readiness levels (TRLs) is illustrated along the example of FPC@DCU's centrifugal microfluidic "Lab-on-a-Disc" (LoaD) platform.

References

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