Microfluidic characterisation of cell mechanical properties

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The clinically most relevant tumour microenvironment (TME) population is represented by T lymphocytes, whose number was demonstrated to be correlated to disease severity, often guiding the stratification of cancer recurrence risk and the therapy choice, particularly in the context of immune checkpoint inhibitor therapies [1,2]. As our knowledge about TME increases, it is becoming crucial to develop fast and user-friendly approaches for the characterization of various cell populations within it. A reliable solution is offered by microfluidic cell sorting. In particular, label-free cell sorting technologies [3] provide separation based on intrinsic cell biomarkers, e.g., size, shape, density, and deformability [4]. For example, in TME, T cells are the smallest (diameter 5-7 μm), with a compact nucleus occupying most of the cell volume: those properties certainly facilitate their discrimination. The mechanical properties of soft particles can be inferred by imaging their deformation in properly designed microfluidic devices [5,6]. To this aim, we consider a microfluidic module with a cross-section variation to induce controlled, non-destructive cell deformation for imaging purposes. Numerical simulations are employed to support device design. In particular, different channel geometry, particle-to-channel relative size, flow conditions, and cell mechanical properties are considered to identify the influence of the operating conditions on bio-particle dynamics.

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