Physics Department Dissertation Defense

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Novel Rheotaxis-based Microfluidic Devices for Sorting Human Sperm

The ultimate challenge for assisted reproductive technologies (ARTs) is to select the most competent sperm population from a semen sample in an efficient way. In this thesis, we report on an effective sperm sorting microfluidic devices that exploit the rheotaxis of sperm and investigates the sperm quality sorted under various flow conditions. Rheotaxis is the ability of a sperm cell to orient itself in the direction of the flow and swim against it. We have developed a novel passively driven pumping system that provides a steady flow rate while it requires no external power source. We have also developed another rheotaxis-based microfluidic device that washes out the raw semen sample from any dead or less motile sperm. The device consists of a collection and waste chamber. To evaluate the effect of the shape and height of the collection chamber, we have measured the sperm motility and velocity parameters after sorting using varying the shape and height of the collection chamber. We have demonstrated that sperm selected with all devices have higher motility, normal morphology, and a fewer degree of DNA fragmentation compared to a control group.