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Fiber-optical devices applied in a biomedical environment

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I'm focusing my research into two main laser applications. The first one, started two years ago, is about the realization and test of an all-fiber total-internal-reflection optical tweezer[1]. Beginning from the classic optical tweezer ideated by Ashkin[2], we want to fabricate an optical device which can trap nano or micro-particles without physical contact. We use a bundle of fibers stuck together with epoxy resin and cut with a focused ion beam (facility) at a specific angle to get a total reflection for the beam: the output beams will converge on the particles creating the optical trap. We can trap and drag one or more particles; we can study, the bacterial adhesion force, the membrane interactions or realizing cell sorting. Currently I'm working on the metallization of these tweezers, so that we can trap particles at longer distance from the probe.
The second project, started this year, is about the realization of an optical stretcher. Thanks to the two-beam optical tweezers configuration [2], it is possible to trap biological particles between two fibers emitting Gaussian beam in the infrared. Then, if we increase the optical power, it is possible to stretch these particles without damage them. In such a way we can study the elasticity of a cell membrane to get new information on the cytoskeletal behavior. Moreover, it is known that tumoral cells are less elastic than healthy ones[3], so the optical stretcher could be a diagnostic non-invasive and safe method to investigate cancer. At the moment we're using a water solution with micro-polystyrene beads, but in a second step we plan to test the device on biological solutions.

References

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