„The accelerator on a chip with a special focus on source requirements"

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Dielectrics at optical frequencies withstand fields up to two orders of magnitude larger than metal cavities of conventional particle accelerators at microwave frequencies. Making use of the advances in nanofabrication and ultrafast lasers, extremely compact accelerating structures can be fabricated on chip including waveguides for laser power delivery. Acceleration [1-3], deflection [3] and focusing [4] of electrons have been experimentally shown and pave the way for an all-optical particle accelerator on a chip. The evanescent character of the accelerating mode requires nanometer sized electron beams and low divergence is needed to accelerate over long distances. Confirmed by simulations, an emittance of 100 pm rad is needed to accelerate more than 50% of the electrons from 83 keV to 1 MeV in 5 mm distance [5]. To achieve sufficiently high field strengths on the order of 1 GV/m without damaging the structures, sub-picosecond laser pulses are typically used. The electron bunch duration needs to be even shorter than the laser pulses to capture the whole charge. To meet these challenging specifications without sacrificing most of the bunch charge, we explore different photocathodes like silicon, tungsten, diamond and $LaB_6$ nanotips and various coatings on the search for a compact electron source with high brightness. As space charge effects eventually limit the bunch charge of every electron source, we also investigate emitter arrays to increase the average current achievable with a dielectric laser accelerator.

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