# Further evidence: Opportunities of scalable and electrostatically optimized electrodes for electric field- and current-driven microfluidic applications

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Silicon-based microfluidics enable the creation of highly complex, three-dimensional fluid networks. These comprise scalable channel sizes and monolithically integrated functionalities available from complementary-metal-oxide-semiconductor technology. On this versatile, solid-state platform, advanced manufacturing techniques exist that allow the channel walls to be directly electrified with one or multiple pairs of electrodes along the fluid-carrying channel. The electrodes have ideal electrostatic geometries, yielding homogeneous electric field distributions across the entire cross section of the microfluidic channel. As these are located directly at the channel, only low supply voltages are needed to achieve suitable field strengths. Furthermore, a controlled supply of charge carriers to the microfluidic channel is feasible. These configurations may serve numerous applications, including highly efficient mechanisms to manipulate droplets, cells, and molecular compounds, perform pico-injection or poration, trigger and control chemical reactions, or realize electrochemical and capacitive sensing modalities. In this perspective, we describe the generic design and fabrication of these electrodes and discuss their miniaturization and scaling properties. Furthermore, we forecast novel use cases and discuss challenges in the context of the most interesting applications.

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