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Resolving Overlimiting Current Mechanisms in Microchannel-Nanochannel Interface Devices GILAD YOSSIFON, NETA LEIBOWITZ, URI LIEL, JARROD SCHIFFBAUER , SINWOOK PARK, Technion - Israel Institute of Technology — We present results demonstrating the space charge-mediated transition between classical, diffusion-limited current and surface-conduction dominant over-limiting currents in a shallow micro-nanochannel device. The extended space charge layer develops at the depleted micro-nanochannel entrance at high current and is correlated with a distinctive maximum in the dc resistance. Experimental results for a shallow surface-conduction dominated system are compared with theoretical models, allowing estimates of the effective surface charge at high voltage to be obtained. Further, we extend the study to microchannels of moderate to large depths where the role of various electro-convection mechanisms becomes dominant. In particular, electro-osmotic of the second kind and electro-osmotic instability (EOI) which competes each other at geometrically heterogeneous (e.g. undulated nanoslot interface, array of nanoslots) nanoslot devices. Also, these effects are also shown to be strongly modulated by the non-ideal permselectivity of the nanochannel.

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