We report an integrated nucleic acid biochip platform that can identify and quantify short nucleic acids in a heterogeneous sample, without PCR amplification, extensive pretreatment and significant target loss. The main components of the integrated biochips are gel, nanoporous membrane and single nanopore components with ion current rectification, inductance, memristor, and negative resistance features. Because of the lossy buffer medium, we rely on these nonlinear, dissipative and nonequilibrium ion current phenomena of the ion-selective media instead of the traditional linear electronic features of voltage/capacitance signals. They allow us to control the on-chip ionic strength, actuate pH by splitting water, concentrate the analyte, separate and isolate molecules and detect specific molecules at single molecular resolution. For example, the concentration polarization action of the ion-selective membrane is used to achieve x1000 concentration against flow dispersion at the pretreatment and preconcentration modules of the chip. A microvortex instability that develops near the membrane is used for nucleic acid sensing, as it produces an inflection point in the I-V curve whose position is sensitive to the presence of charged nucleic acids hybridized to the surface-functionalized oligo probes. Regeneration and selectivity enhancing wash can be actuated with on-chip bipolar membrane modules that can control the buffer pH between 2 to 10 with a water-splitting reaction at their junctions. The result is a sensitive integrated platform that can identify and quantify nearly identical multiple short nucleic acids with small copy numbers. We also report current efforts to extend this platform to massively parallel memristor circuits for the analysis of a large number of molecules.