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grow in complexity, a proper
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Nanofluidic devices have the

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*potential to offer unique
functionality by exploiting
length scales comparable to
the Debye length or the size
of individual biomolecules.
Integration of nanofluidics
with microfluidics also has*

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potential benefits as a system can thereby draw from the benefits of both technologies. To leverage these functionalities, the physics associated with interfacing microchannels

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and nanochannels needs to be understood rigorously. In particular, when current is applied across a microchannel-nanochannel interface, surface charge effects inside the

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nanochannel often lead to an imbalance of fluxes of positive and negative species. This, in turn, creates a region of high ionic strength on one side of the nanochannel and low ionic

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strength on the other side, a phenomena known as concentration polarization (CP). Prior work on the physics of microchannel-nanochannel interfaces has neglected several key issues

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which we will address in this work. We review an analytical model of propagating CP and present experimental and computational validation of this model. In particular, our

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results show that enrichment and depletion regions propagate as 'shockwaves' of concentration which can profoundly change the flow and electric field conditions in a microfluidic system.

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Additionally, we present new analytical model which predicts the behavior of analyte ions in a microchannel-nanochannel system with CP. This work shows that CP can restrict

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the transport of analyte ions such that they cannot reach all regions of a microfluidic-nanofluidic system. The effects of CP, therefore, must be considered in the design of microfluidic-nanofluidic

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*systems for biological or
chemical analysis. Finally we
present the first
simultaneous visualization of
nanochannel ionic strength
and conductance. Our
experiments show that, for*

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some cases, the propagating CP model is a fair predictor of trends in nanochannel concentration. However, in some cases, the concentration inside the nanochannel reaches a

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*temporary 'meso' state
before transitioning to a
final, significantly different
concentration which is not
described by theory. The
latter shows that there is yet
much room for further*

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when classical theory breaks
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received significant research interest in recent years, particularly in regards to the advantageous exploitation of nonlinearities. Harnessing the dynamics of bistable structures--that is, systems

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and experimentation that are widely useful in the assessment of the dynamics of bistable structures Details approaches to evaluate, by analytical and numerical analysis and experiment, the

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influences of harmonic and random excitations, multiple degrees-of-freedom, and electromechanical coupling towards tailoring the underlying bistable system dynamics Establishes how

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intelligently utilizing bistability could enable technology advances that would be useful in various industries, such as automotive engineering, aerospace systems, microsystems and

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innovative ideas that, by
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**elements of modern
technology and everyday
life. Examples of shell
structures in technology
include automobile
bodies, water and oil
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shell, the diaphragm, the
skin and the pericardium
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