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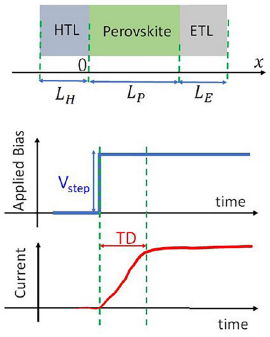
Though previously thought to affect the devices' current time delay after a voltage is applied, ion mobility turns out to only play a role when the voltage is small.



Like a water tank that needs to be filled a certain amount before water can emerge from its elevated faucet, perovskite diodes exhibit a transient phase, which requires electric charge to build up before the device reaches a steady state with constant current flow. This behavior results in a time delay between when the signal is switched on and when current begins to flow, which is commonly expected to scale inversely with the mobility of the ions in the perovskite.

Exploring this phenomenon in detail, Saketh et al. uncovered a puzzle. The time delay only scales with ion mobility for small signal switching. For large signal switching, the two seem to be unrelated.

"The role of mobile ions in perovskite devices is very complex, and the understanding of its impact is still evolving," said author Pradeep Nair. "As a result, the experimental trends from various labs are still not amenable to interpretation from a coherent, uniform perspective."

In the water tank analogy framework, the group found the amount of voltage applied affects the shape of the tank, which, in turn, affects the current through the device. For large voltages, this phenomenon results in the behavior of electrons playing a dominant role over the behavior of ions.

They confirmed this behavior by comparing experimental data from different labs, many obtained with different perovskite properties. Indeed, the time delays in the various experimental reports did not follow the expected scaling relation when the applied voltage was sufficiently large, and the group's numerical simulations provided a suitable explanation as to why.

Further insights into these complex dynamics may help optimize opto-electronic applications, such as solar cells and LEDs, which are influenced by these effects.

Source: "Ion mobility independent large signal switching of perovskite devices," by Tirupati Saketh Chandra, Abhimanyu Singareddy, Kashimul Hossain, Dhyana Sivadas, Swasti Bhatia, Shivam Singh, Dinesh Kabra, and Pradeep R. Nair, *Applied Physics Letters* (2021). The article can be accessed at https://doi.org/10.1063/5.0051342.