Strong light-matter interaction in ferroelectric materials

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In the pursuit of ultra-efficient nanoelectronic devices for the next generation of non-volatile memories, ferroelectric materials have emerged as a focal point of extensive research and interest. This heightened attention stems from their distinct properties, including rapid response speed, non-volatility, and low power consumption [1, 2].

Traditionally, polarization switching in ferroelectric devices has relied on static electric fields. However, achieving a stable switching through single light pulses remains a challenge. Yet, such an accomplishment holds the promise of offering unique advantages, including ultrafast operation, non-contact switching, and retention-loss suppression. In conventional ferroelectric perovskites, such as $LiNbO_3$, $BaTiO_3$ and $PbTiO_3$, only a transient switching under single THz pulses has been theoretically demonstrated [3, 4, 5]. This can be attributed to the dominance of appearing depolarization fields in the switched domains [6] and inter-domain phonon interactions, resulting in the destabilization of the reversed state.

In our research, we are exploring ferroelectric systems and mechanisms capable of achieving permanent switching in response to single THz pulse perturbations. We propose that light pulse-driven ferroelectric switching can substantially improve the switching properties and pave the path for commercialization of the ferroelectric memories.

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