Adsorption-controlled epitaxial growth of the hyperferroelectric candidate LiZnSb on GaSb (111)

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A major challenge for ferroelectric devices is the depolarizing field, which competes with and often destroys long-range polar order in the limit of ultrathin films. Recent theoretical predictions suggest a new class of materials, termed hyperferroelectics [1], should be immune to the depolarizing field and enable ferroelectric devices down to the monolayer limit. Here we demonstrate the epitaxial growth of hexagonal LiZnSb, one of the hyperferroelectric candidate materials, on GaSb (111) substrates. Due to the high volatility of all three atomic species, we find that stoichiometric films can be grown in a thermodynamically adsorption-controlled window, using an excess zinc flux. Outstanding challenges remain in controlling the point defects of LiZnSb and in controlling polytypism. While the films primarily grow in a hexagonal "stuffed wurtzite" phase (space group $P6_3mc$), which is has the desired polar structure, there exists a competing cubic "stuffed zincblende" polymorph that is nonopolar (*F-43m*). We will discuss our strategy towards controlling defects and polytypism in LiZnSb, which is based in large part on the wurtzite – zincblende polytypism observed in InAs. We will also present preliminary electrical measurements on phase pure ferroelectric capacitor structures. This work was supported by the Army Research office (W911NF-17-1-0254) and the National Science Foundation (DMR-1752797) .

[1] K. F. Garrity, K. M. Rabe, and D. Vanderbilt, Phys. Rev. Lett. **112**, 127601(2014).

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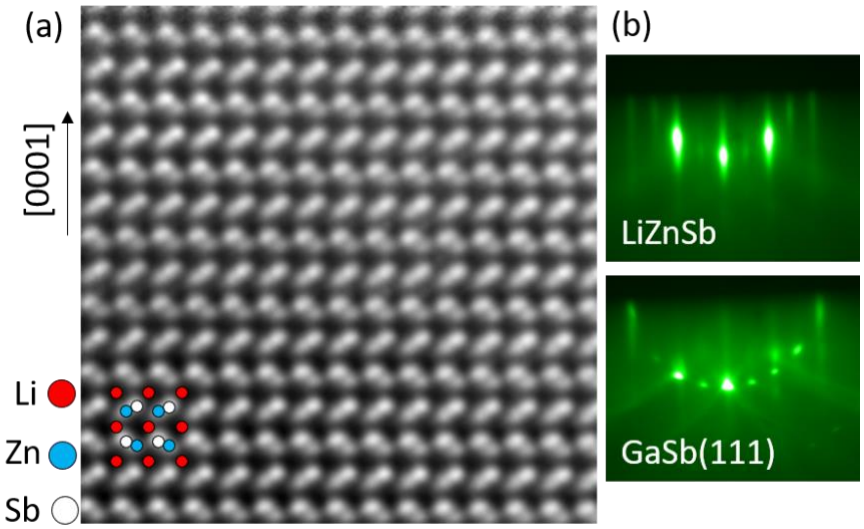

Figure 1 (a) HAADF-STEM image of LiZnSb, showing the polar structure. (b) RHEED patterns for the LiZnSb and GaSb (111) buffer layer.