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Accelerating Solid-state Battery Research through Ultrafast and Precise Synthesis

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Solid-state electrolyte is the key limiting material for solid-state batteries, but their discovery and precise synthesis are hindered by time- and labor-intensive processes, especially for materials with complex compositions and structures. To overcome this challenge, we propose a general principle termed inducer-facilitated assembly through structural templating (i-FAST), which enables ultrafast (within a few seconds) and precise synthesis of high-purity solid electrolytes by steering reactions along predefined pathways via structurally templated intermediates. The i-FAST approach ensures thermodynamic favorability for intermediate formation and kinetic preference toward the final product. We demonstrate its effectiveness with the rapid synthesis of three representative oxide materials relevant to solid-state electrolytes: garnet, perovskite, and pyrochlore. This work not only advances the understanding of thermodynamics and kinetics in solid-phase synthesis but also provides a practical strategy to accelerate the development of solid-state electrolytes.