

From Flash Sintering to Field-Free Ultrafast Sintering and Electric-Field-Driven Microstructure Control

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In 2015, we first reported that flash sintering generally initiates as a thermal runaway [Acta Mater. 94:87 (2015)]. Subsequent work demonstrated that ultrahigh heating rates of 100K/s, rather than the electric field, are the key factor enabling ultrafast sintering, via comparing flash sintering with rapid thermal annealing without an electric field [Acta Mater. 125:465 (2017)]. Subsequently, general ultrafast sintering methods based on the same mechanism, including ultrafast high-temperature sintering (UHS) [Science 368:521 (2020)] and plasma sintering [Nature 623:964 (2023)], have been developed in collaborative studies. Most recently, we further reported induction ultrafast sintering (IUS) [Scripta Mater. 272:117066 (2026)].

Although ultrafast sintering can be achieved without an electric field, electric fields can significantly influence microstructural evolution. We discovered an electrochemically induced grain-boundary disorder–order transition that triggers abnormal grain growth in Bi₂O₃-doped ZnO [Nature Commun. 12:2374 (2021)]. We further showed that applied electric fields can induce grain-boundary oxidation transitions near the anode, producing continuously graded microstructures in undoped ZnO [Mater. Today 73:66 (2024)]. Moreover, the polarity of graded microstructures in BaTiO₃ can be reversed through a grain-boundary disordering transition: grain growth occurs at the anode at 5 V, but shifts to the cathode at 15 V [J. Eur. Ceram. Soc. 46:118104 (2026)].

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

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Invitation letter for visa

Yes

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