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Size-scaling behavior of hydriding phase transformations in nanocrystals LESTER HEDGES, RIZIA BARDHAN, Lawrence Berkeley National Laboratory, CARY PINT, ALI JAVEY, University of California, Berkeley, STEPHEN WHITELAM, JEFFREY URBAN, Lawrence Berkeley National Laboratory — By partnering data obtained from a novel in-situ luminescence-based probe with a statistical mechanical model we derive size-scaling laws for hydriding phase transformations relevant for hydrogen storage. We conclude that the observed experimental trends are consistent with thermally-driven nucleation, and derive scaling relations that reveal the fundamental size-dependence of nucleation barriers in nanocrystals for first-order phase transformations: near the critical point, the barrier to nucleation is controlled directly by the size of the nanocrystal. Consequently, phase transformation can occur in a nanocrystal even at the critical point, in stark contrast to the classical bulk scenario. Our results provide a detailed framework for understanding how nanoscale interfaces impact broad classes of thermally-driven solid-state phase transformations of relevance for hydrogen storage, catalysis, batteries, and fuel cells.

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