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Electric Field Induced Phase Transitions MARCO NARDONE, Bowling Green State University, Bowling Green, Ohio, VICTOR KARPOV, University of Toledo, Toledo, Ohio — A novel theory of phase transitions that are driven by strong, symmetry-breaking electric fields is presented. The underlying mechanism is based on the formation of needle-shaped, metallic embryos that acquire strong dipole moments in the applied field. It is shown that the electrostatic contribution to the free energy can be so significant that it dominates the nucleation process and elongated metallic particles can form even in cases where they would be otherwise unstable in the bulk. As such, the theory predicts that any insulator will eventually form metallic inclusions when immersed in a sufficient electric field. Materials can thus be synthesized by the controlled application of a dc or laser field. In this work, the general mechanism is described and closed form expressions are presented for the field-dependent nucleation barrier and the effective field range as functions of material parameters. Overall, the theory presents a new parameter space to explore phase transitions and opens the venue of Field Induced Materials Synthesis (FIMS). As a provocative example, the potential for FIMS of metallic hydrogen at standard pressure is discussed; the effective field range is estimated to be $10^7 < E \ll 10^9$ V/cm (laser intensity $10^{12} < I \ll 10^{16}$ W/cm^2).

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