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Thermodynamic and Kinetic differences between solid superheating and liquid supercooling XIAN-MING BAI, MO LI, School of Materials Science and Engineering, Georgia Institute of Technology — When surface melting is properly suppressed, a solid can be heated above its melting temperature, which is called superheating. Although many explanations were proposed for solid superheating in the past century, its nature and extent still remain veiled. It is commonly assumed that solid superheating is a reverse process of liquid supercooling. The classical nucleation theory was directly applied to estimate the liquid nucleation rate and the upper limit of superheating despite the lack of decisive test of this analogy. Here we present our investigation of the thermodynamic and kinetic differences between superheating and supercooling via molecular-dynamics simulations. It is shown that the large elastic energy associated with internal melting and solid-liquid interface disorder play important roles in superheating. The growth rate is anisotropic for supercooling, but isotropic for superheating. Supercooling can be well described by the classical nucleation theory, whereas superheating shows many exceptions. The underlying mechanisms for these differences are discussed.

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