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Nonhysteretic superelasticity of shape memory alloys at nanoscale ZHEN ZHANG, Iowa State University, XIANGDONG DING, XIAOBING REN, Xi'an Jiaotong University, KAZUHIRO OTSUKA, National Institute for Materials Science — Superelasticity with recoverable strains about 8% is known to appear in shape memory alloys (SMAs) possessing a spontaneous martensitic transformation (MT). However, it is unknown whether such a property can still exist below the critical size where MT disappears. We perform molecular dynamics simulations to show that SMA nanoparticles below the critical size not only demonstrate superelasticity but also exhibit features such as absence of hysteresis, continuous nonlinear elastic distortion, and high blocking force. Atomic level investigations show that this nonhysteretic superelasticity results from a continuous transformation from the parent phase to martensite under external stress. This aspect of SMAs is attributed to a surface effect; i.e., the surface locally retards the formation of martensite and then induces a critical-end-point-like behavior when the system is below the critical size. Our work potentially broadens the application of SMAs to the nanoscale. It also suggests a method to achieve nonhysteretic superelasticity in conventional bulk SMAs.

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