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Structured block copolymer thin film composites for ultra-high energy density capacitors[1] SAUMIL SAMANT, University of Akron, SHIMELIS HAILU, Howard University, CHRISTOPHER GRABOWSKI, MICHAEL DURSTOCK, Air Force Research Lab, WPAFB, DHARMARAJ RAGHAVAN, Howard University, ALAMGIR KARIM, University of Akron — Development of high energy density capacitors is essential for future applications like hybrid vehicles and directed energy weaponry. Fundamentally, energy density is governed by product of dielectric permittivity ε and breakdown strength V_{bd}. Hence, improvements in energy density are greatly reliant on improving either ε or V_{bd} or a combination of both. Polymer films are widely used in capacitors due to high Vbd and low loss but they suffer from very low permittivities. Composite dielectrics offer a unique opportunity to combine the high ε of inorganic fillers with the high V_{bd} of a polymer matrix. For enhancement of dielectric properties, it is essential to improve matrix-filler interaction and control the spatial distribution of fillers for which nanostructured block copolymers BCP act as ideal templates. We use Directed Self-assembly of block copolymers to rapidly fabricate highly aligned BCP-TiO2 composite nanostructures in thin films under dynamic thermal gradient field to synergistically combine the high ε of functionalized TiO2 and high V_{bd} of BCP matrix. The results of impact of BCP morphology, processing conditions and concentration of TiO2 on capacitor performance will be reported.

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