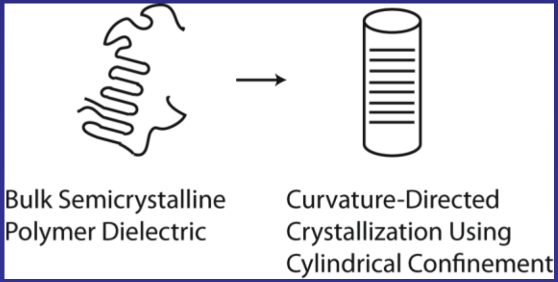
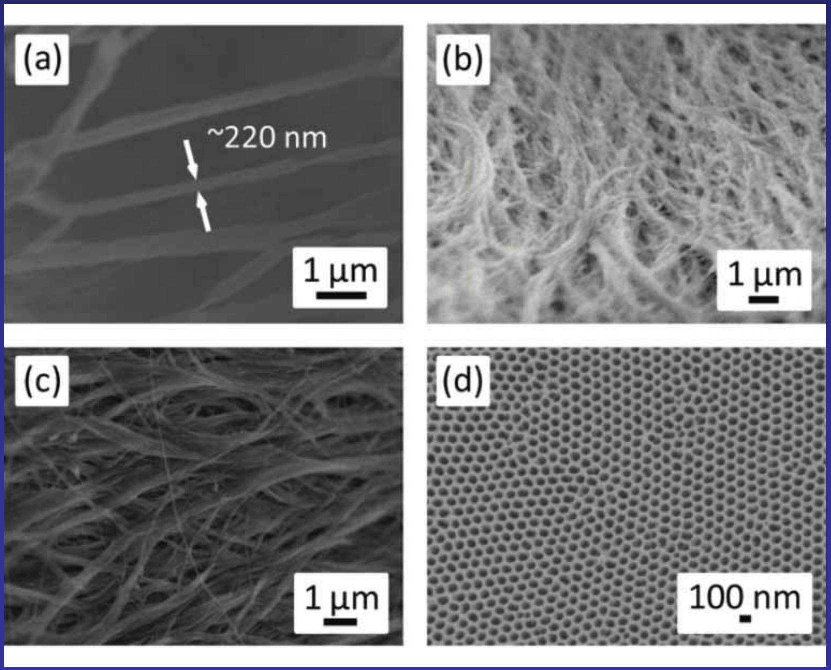
Curvature-Directed Crystallization of Polymer Dielectrics

Jodie L. Lutkenhaus, Department of Chemical Engineering, Texas A&M University

Capacitors based on polymer dielectrics are leading energy storage technologies because of their high reversibility and cyclability, fast response time, self-healing properties, and high power density. However, capacitor energy density – which is limited by dielectric breakdown strength (DBS) and loss - is generally low. Our scientific objective is to enhance and control the dielectric properties of popularly used polymer dielectrics (isotactic poly(propylene), poly(vinylidene fluoride), poly(ethylene terepthalate)) via curvature-directed crystallization, which is the crystallization of a polymer confined within a cylindrical nanoscale pore. As the diameter of the pore decreases, the degree of curvature substantially increases, leading to new and interesting properties. We have successfully demonstrated the curvature-directed crystallization of isotactic propylene, and we plan to exploit our control over crystallization to manipulate dielectric properties. Other notable findings include:

- As diameter decreases,
  - Equilibrium melting temperature decreases
  - Homogeneous crystallization dominates
  - Crystals become highly oriented in one dimension





TEXAS A&M UNIVERSITY