

Figure s1 SEM images of the unusual  $\text{CaCO}_3$  crystals obtained at different reaction times: panels (a), (b), and (c) show the crystals sampled at the aging times of 5, 10 and 20 min, respectively.

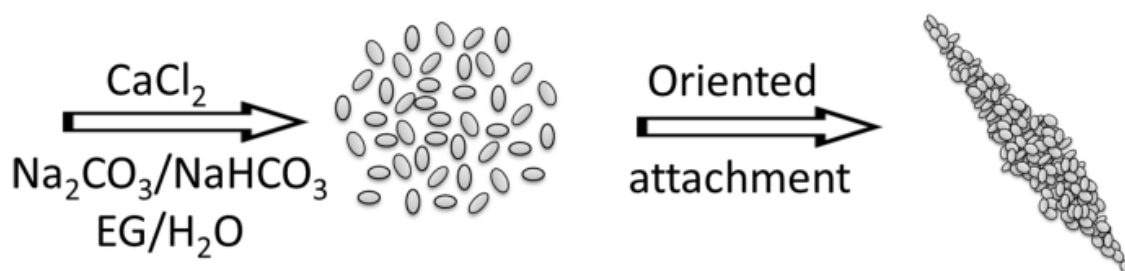


Figure s2 Schematic illustration of a formation process for the spica-like hierarchical  $\text{CaCO}_3$ .

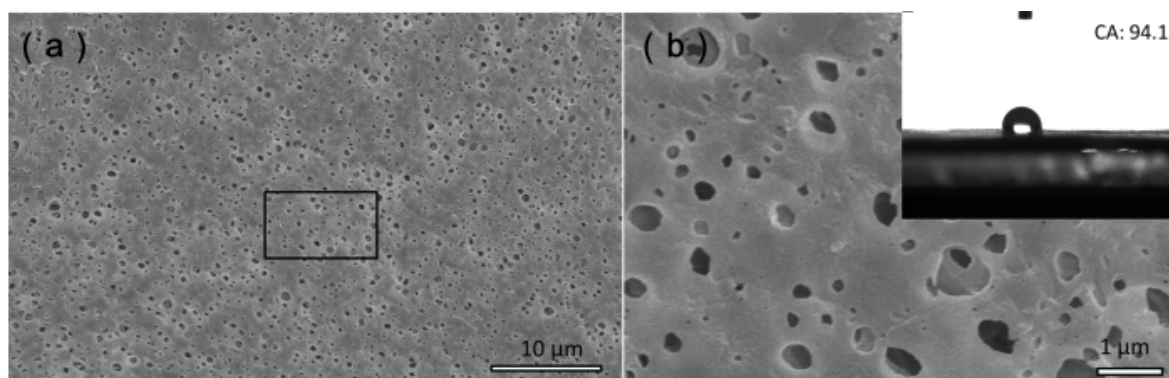


Figure s3 (a) Virgin pvdf membrane has pore morphology, (b) high-magnification view of the black box in (a). Inset in (b) indicates water contact angles of the virgin pvdf membrane.