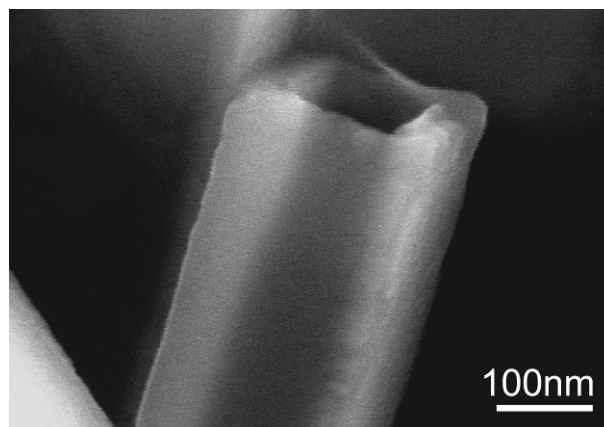
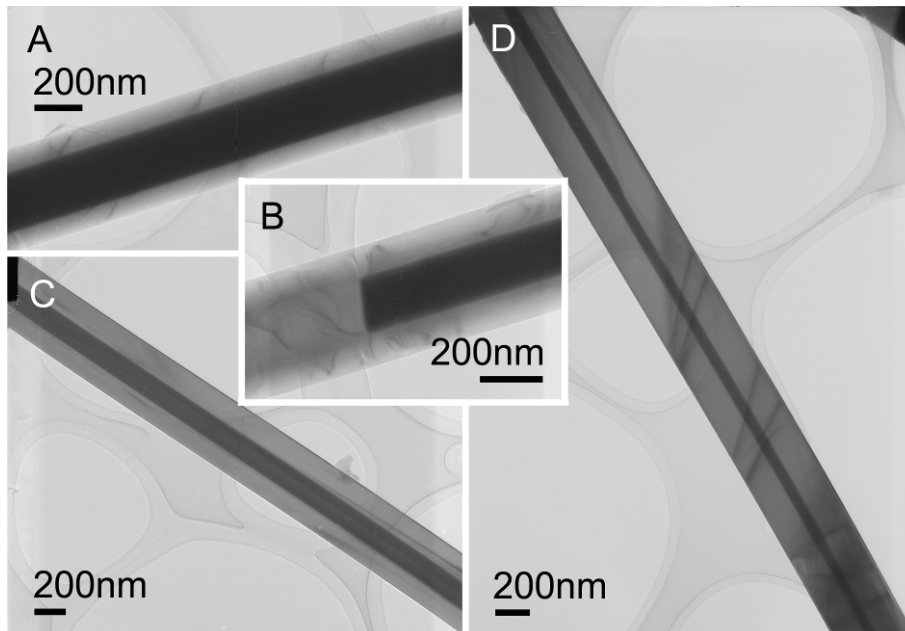


**SUPPORTING INFORMATION PARAGRAPH**

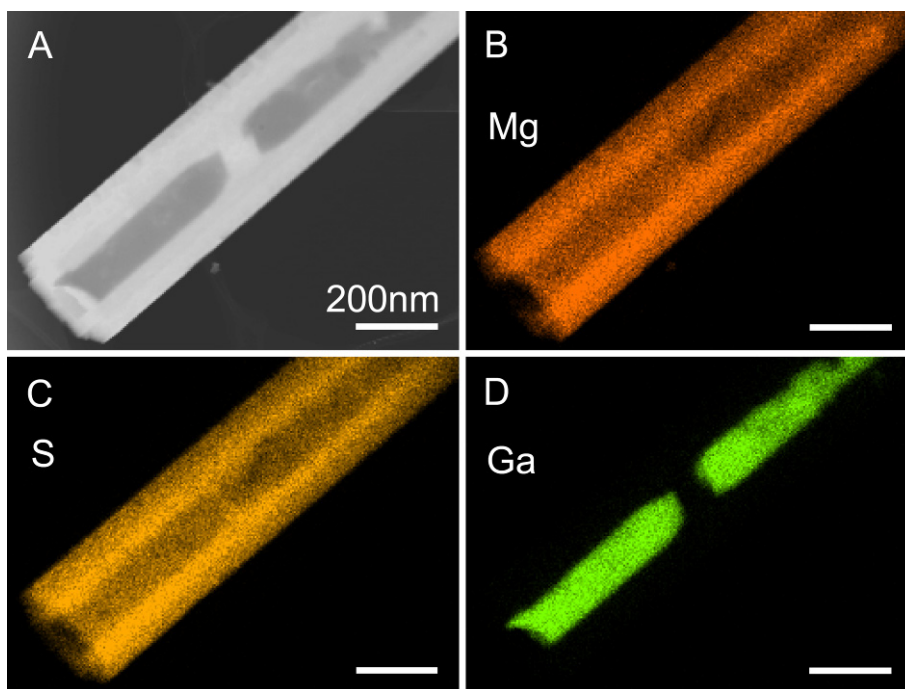


*SI-Fig. 1* High-magnification SEM image clearly reveals as-grown MgS nanotubes having a square-shaped cross-sections.



*SI-Fig. 2* TEM images of MgS nanotubes filled with liquid Ga. These tubes have an outer diameter of  $\sim 400$  nm, whereas the inner diameters of the channels determining the diameters of Ga columns have a rather wide distribution in the range of  $\sim 50$ - $300$

nm. The as-synthesized MgS tubes were either partially filled (B) or completely filled with Ga (A, C, D) forming Ga/MgS core/shell composite nanowires or Ga-MgS metal-semiconductor nanowire heterostructures.



*SI-Fig. 3* (A) STEM image of a liquid Ga filled MgS nanotube. (B) Mg, (C) S and (D) Ga elemental maps demonstrate well-defined composition variations within this composite nanowire filled tubular structure.