

Supporting Information

Self-assembled Zirconia Nanotube Arrays: Fabrication Mechanism, Energy Consideration and Optical Activity

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Effect of Solvent Composition:

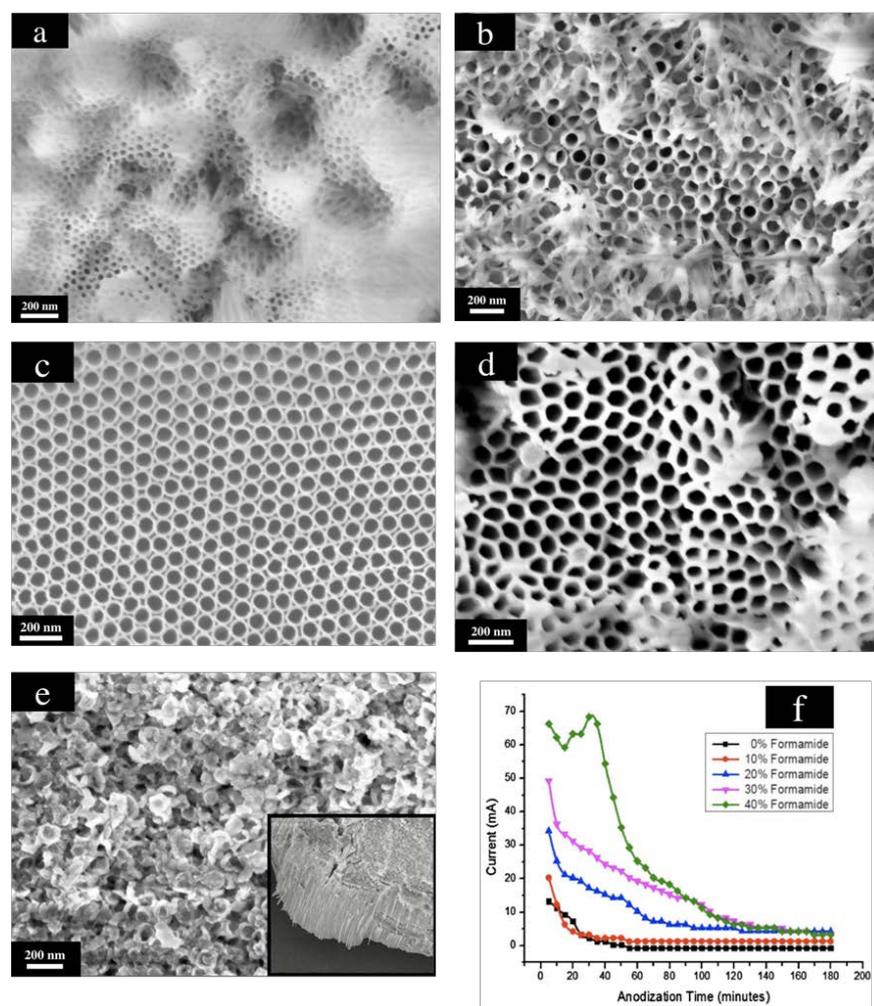


Figure S1. FESEM images of as-grown ZrO₂ nanotube arrays via anodic oxidation for 3hrs @50V in glycerol electrolytes containing 4wt% H₂O and 1wt% NH₄F, along with (a) 0% FA, (b) 10% FA, (c) 20% FA, (d) 30% FA, and (e) 40% FA. Panel (f) shows the time-dependant anodization current curves for different electrolyte compositions.

Effect of Fluoride and Water Contents:

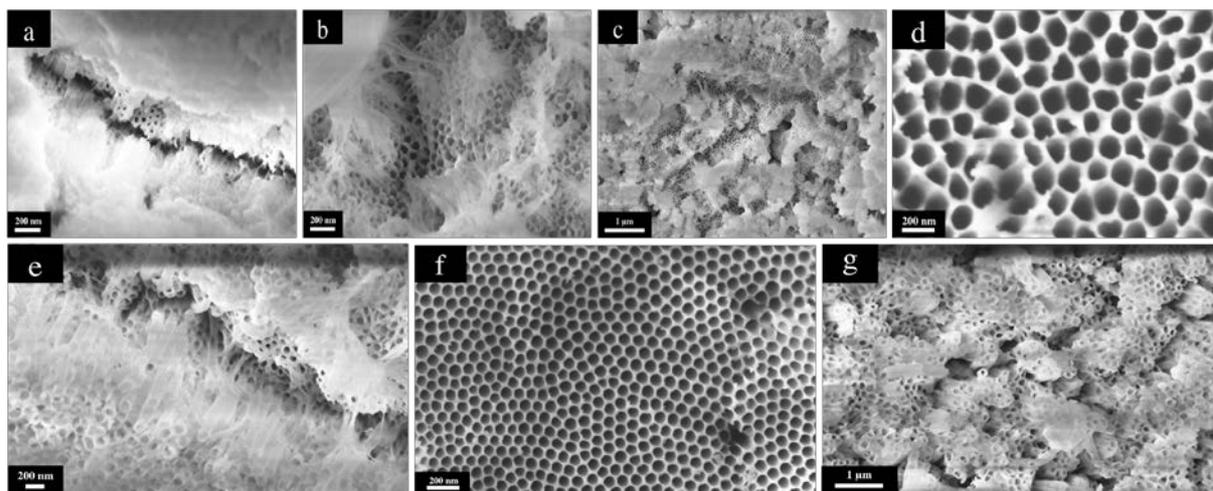


Figure S2. FESEM images of as-grown ZrO_2 nanotube arrays via anodic oxidation for 3hrs @50V in glycerol electrolytes containing 20% FA, along with (a) 0.5wt% NH_4F and 2wt% H_2O , (b) 0.5wt% NH_4F and 3wt% H_2O , (c) 0.5wt% NH_4F and 4wt% H_2O , (d) 1wt% NH_4F and 2wt% H_2O , (e) 1wt% NH_4F and 3wt% H_2O , (f) 2wt% NH_4F and 2wt% H_2O , (g) 2wt% NH_4F and 4wt% H_2O .

Effect of Anodization Time:

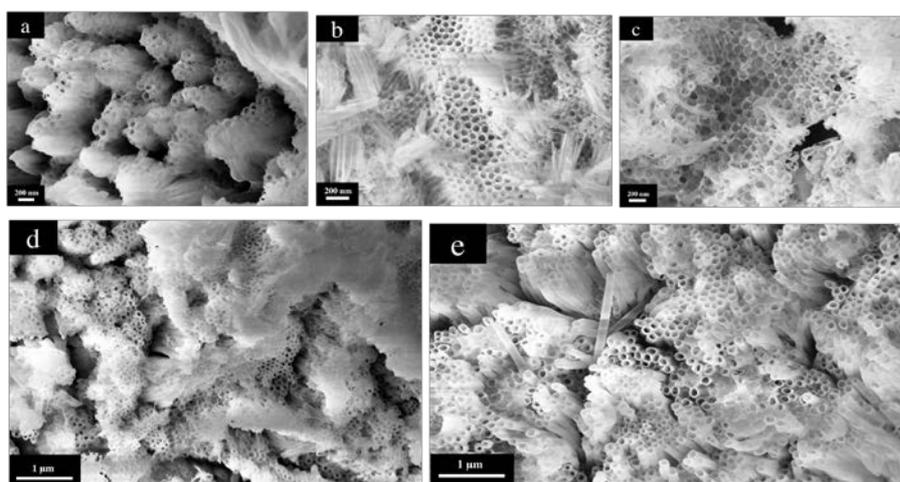


Figure S3. FESEM images of as-grown ZrO_2 nanotube arrays via anodic oxidation @50V in glycerol electrolytes containing 20% FA, 4wt% H_2O and 1wt% NH_4F , for a duration of (a) 1hr, (b) 2hrs, (c) 5hs, (d) 6hrs, and (e) 16hrs.

Effect of Applied Anodization Voltage:

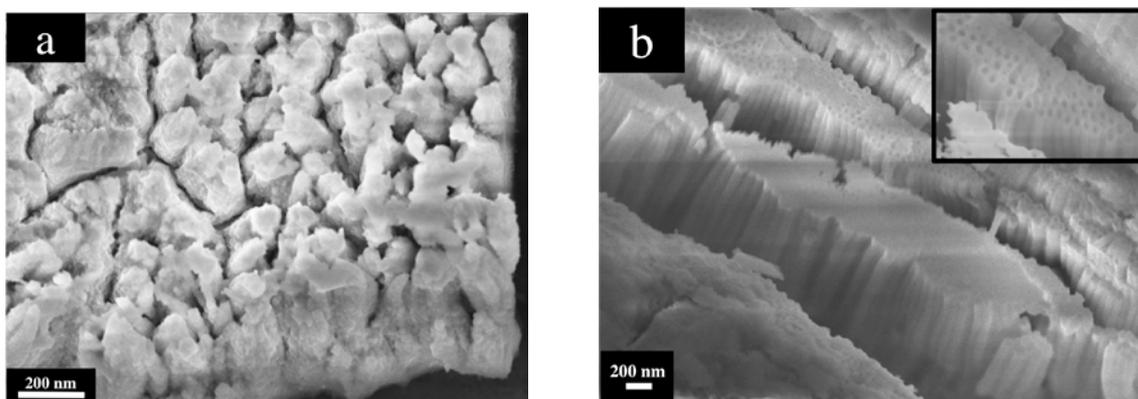


Figure S4. FESEM images of as-grown ZrO_2 nanotube arrays via anodic oxidation for 3hrs in glycerol electrolytes containing 20% FA, 4wt% H_2O and 1wt% NH_4F , (a) @10V and (b) @30V.

Table S1. ZrO_2 nanotube lengths, diameters, and wall thicknesses with varying FA contents in electrolytes.

Percent Formamide	Tube Diameter (nm)	Wall Thickness (nm)	Tube Length (μm)
0%	30	5	6.4
10%	74	7.8	10
20%	82	11.5	24.8
30%	80	14	48
40%	80	13	48

Table S2. Variation of ZrO₂ nanotube lengths (μm) with varying NH₄F and H₂O weight content in electrolytes.

	0.5wt% NH ₄ F	1wt% NH ₄ F	2 wt% NH ₄ F
2wt% H ₂ O	20.4	15	11.1
3wt% H ₂ O	30	23	18
4wt% H ₂ O	35	24.8	20