

Electronic supplementary information

Hydrothermal Synthesis of Titanate Nanotubes from TiO₂ Nanorods Prepared via a Molten Salt Flux Method as an Effective Adsorbent for Strontium Ion Recovery

Love Kumar Dhandole^{‡a}, Jungho Ryu^{‡b}, Jeong-Muk Lim^a, Byung-Taek Oh^a, Jung
Hee Park^a, Byoung-Gyu Kim^{*b} and Jum Suk Jang^{*a}

*^aDivision of Biotechnology, Advanced Institute of Environment and Bioscience, College of
Environmental and Bioresource Sciences, Chonbuk National University, Iksan, 54596, Korea*

*^bMineral Resources Research Division, Korea Institute of Geoscience and Mineral
Resources, Daejeon 34132, Korea.*

† Equal contribution

*Corresponding author, Tel.: +82 63 850 0846; fax: +82 63 850 0834.

E-mail addresses: jangjs75@jbnu.ac.kr (J.S. Jang); kgbkim@kigam.re.kr (B.G. Kim).

Table S1

Particle size and powder yield of nanomaterials.

| Samples | Nanorods | TNTs-1D | TNTs-2D | TNTs-3D |
|--|-----------------|----------------|----------------|----------------|
| ^aNano powder yield (in gm) | 0.920 | 0.506 | 0.560 | 0.610 |
| ^bExternal diameter (or width) of single particle (in nm) | 160–300 | 20–35 | 16–25 | 30–60 |

^a Nanopowder yield after washing and drying in an oven overnight (g).

^b Nanomaterial external diameter or width of a particle, based on FESEM images (nm).

Figure captions

Fig. S1 Effect of the HT reaction time on the formation of nanotubes from nanorods (in 10 M NaOH at 160°C), FESEM images of (a) molten salt NRs, (b) 6 h and (c) 12 h samples; nanotubes formed on the surfaces of the NRs, (d) 24 h (1D); most NRs had transformed into nanotubes, (e) 48 h (2D); NRs completely disappeared, (f) 72 h (3D); nanotubes folded together due to a prolonged reaction, revealing solid, rod-like structures.

Fig. S2 FE-SEM images of admixture nanoparticles (both untransformed NRs and TNTs) following the reaction over (a) 6 h, (b) 12 h, (c) 1D, (d) 2D, and (e) 3D at 160°C.

Fig. S3 (A) BJH pore size distribution, and (B) nitrogen adsorption and desorption isotherms obtained from the TiO₂ nanorods.

Fig. S4 Effect of mixed cations (Sr²⁺/ Ca²⁺) solution over strontium uptake by TNTs-2D. The varying Ca²⁺ concentrations are (0, 100, 200, 300, 400 mg L⁻¹) and fixed Sr²⁺ (10 mg L⁻¹) with 30 min contact time. Inset image: Equimolar Sr (mmol/g) and Ca (mmol/g) adsorption curve for TNT-2D nanomaterial adsorbents in seawater.

Fig. S5 Effect of calcination on the TNT-2D adsorbents over time, and Sr²⁺ adsorption as a function of the Sr²⁺ concentration.

Fig. S6 Comparison of the k²-weighted Fourier transform of the theoretical scattering patterns from the Ti-Na and Ti-Sr²⁺ interactions in the titanate structure.

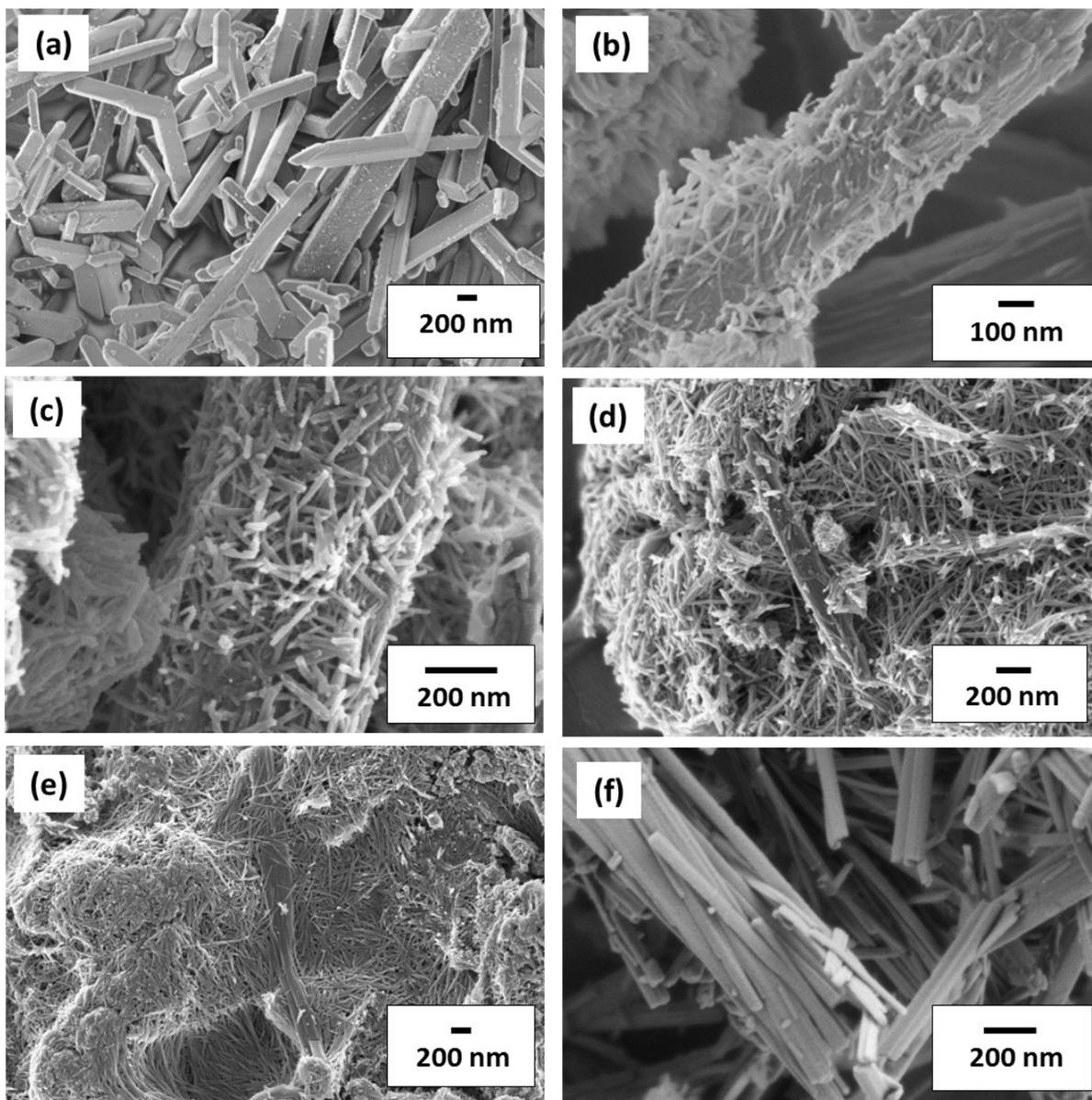


Fig. S1

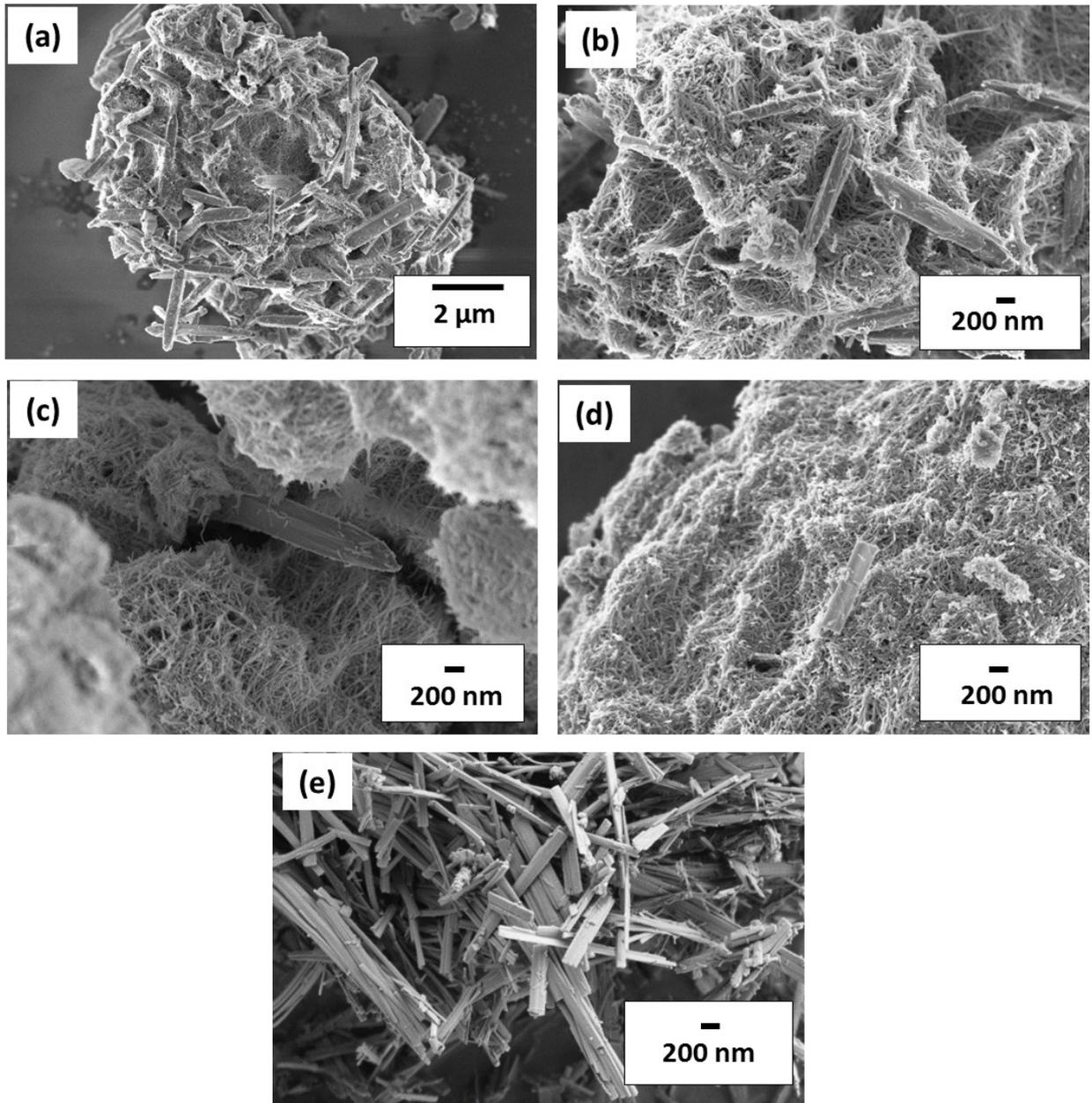


Fig. S2

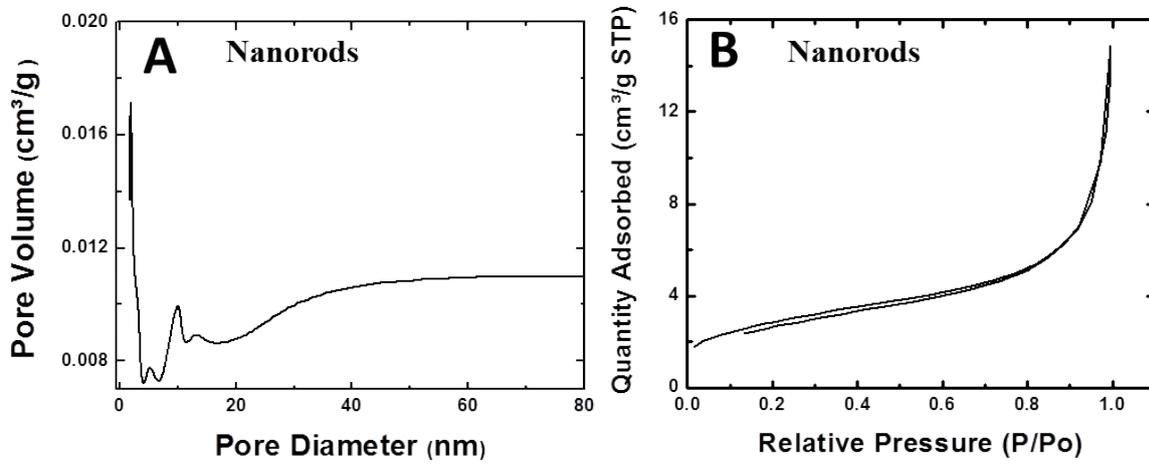


Fig. S3

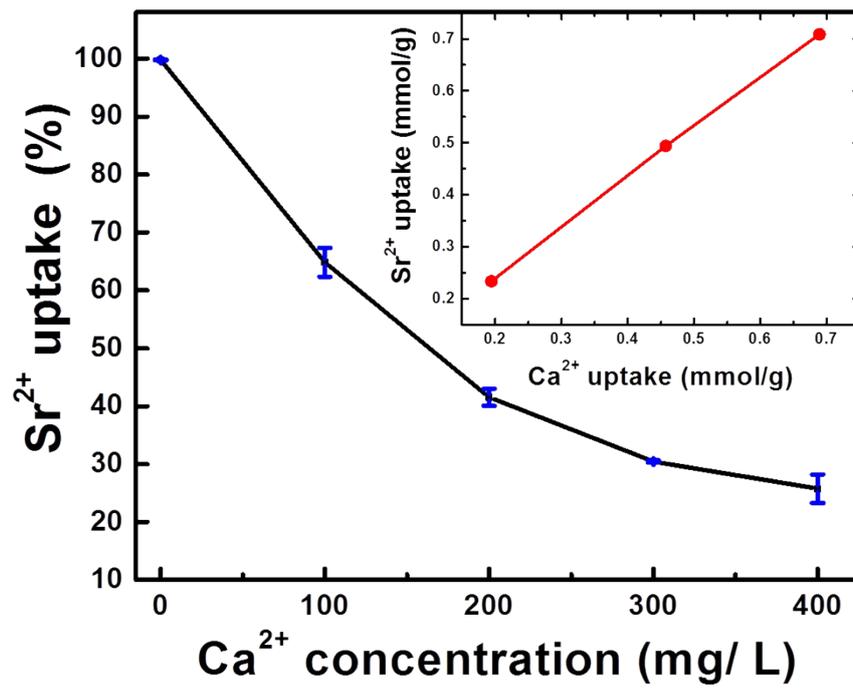


Fig. S4

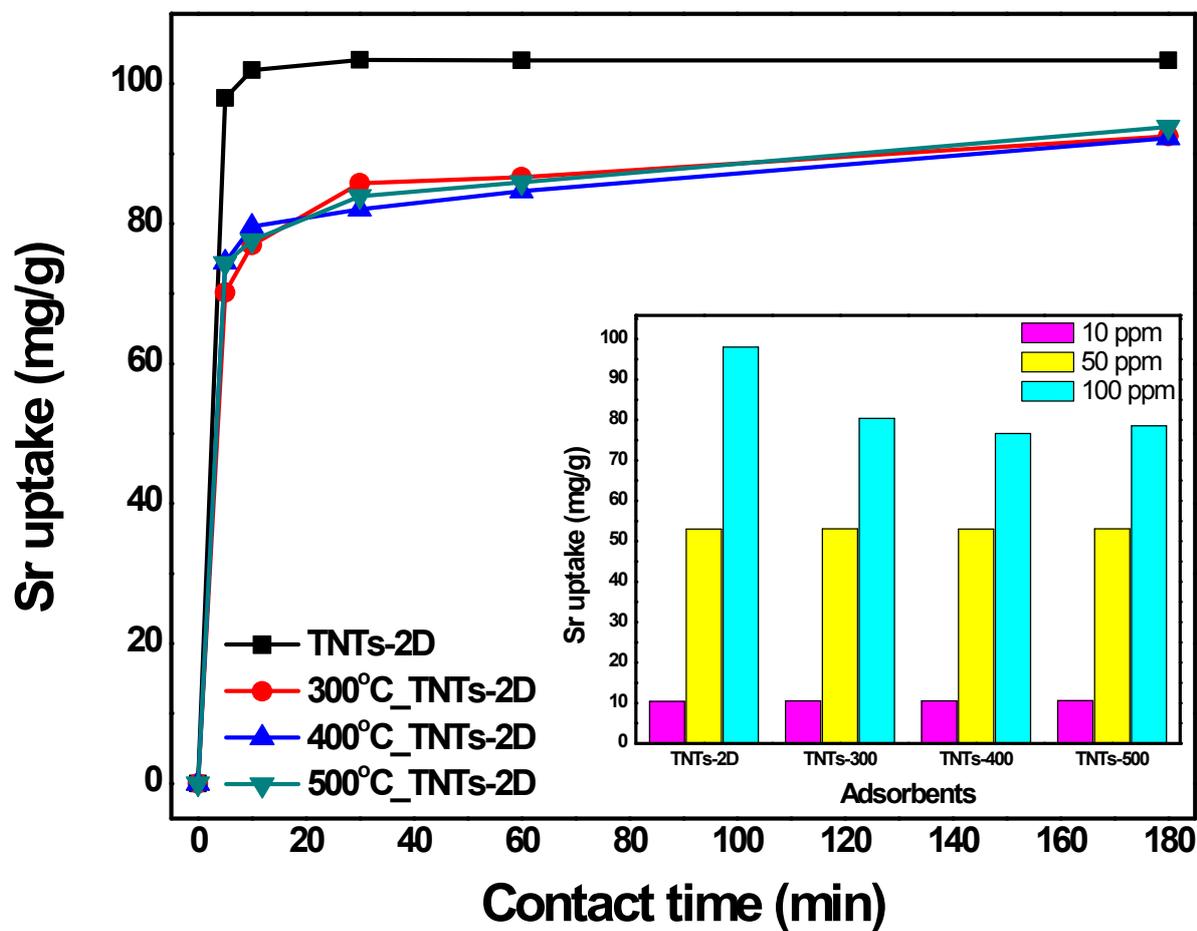


Fig. S5

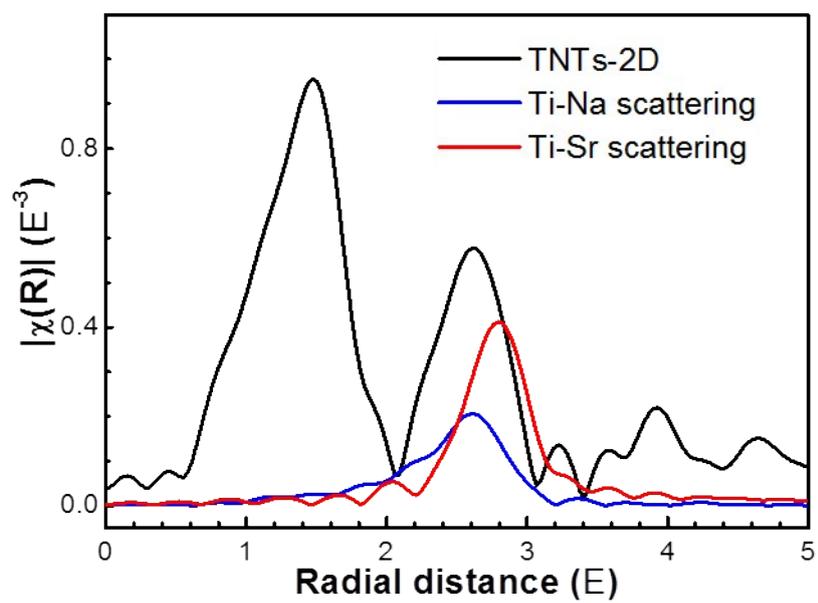


Fig. S6