Electronic Supplementary Material (ESI) for Chemical Communications

Supporting Information for

Hybrid Cooperative Binary Ionic Porphyrin Nanocomposites

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Table S1. Angles (2θ) in degrees of main X-ray reflections for various porphyrin CBI clovers and their hybrid nanocomposites. Peak positions taken from Lorentzian spectral fits (±0.05º).

Structure	1	2	3	4	5	6	7	8
Sn/Zn	7.72	11.06	15.72	19.23	20.88	25.04	29.63	39.70
Sn/Co	7.93	11.16	15.79	19.36	21.64	25.31	29.79	-
Zn/Sn	7.85	11.10	15.60	19.55	-	25.75	29.85	39.70
Zn/Co	7.95	11.15	15.85	19.35	22.70	-	29.95	39.70
20% Sn/Co-Sn/Zn	8.11	11.42	16.04	19.54	21.25	25.44	29.96	-
40% Sn/Co- Sn/Zn	7.97	11.34	15.97	19.45	21.18	25.31	29.84	39.65

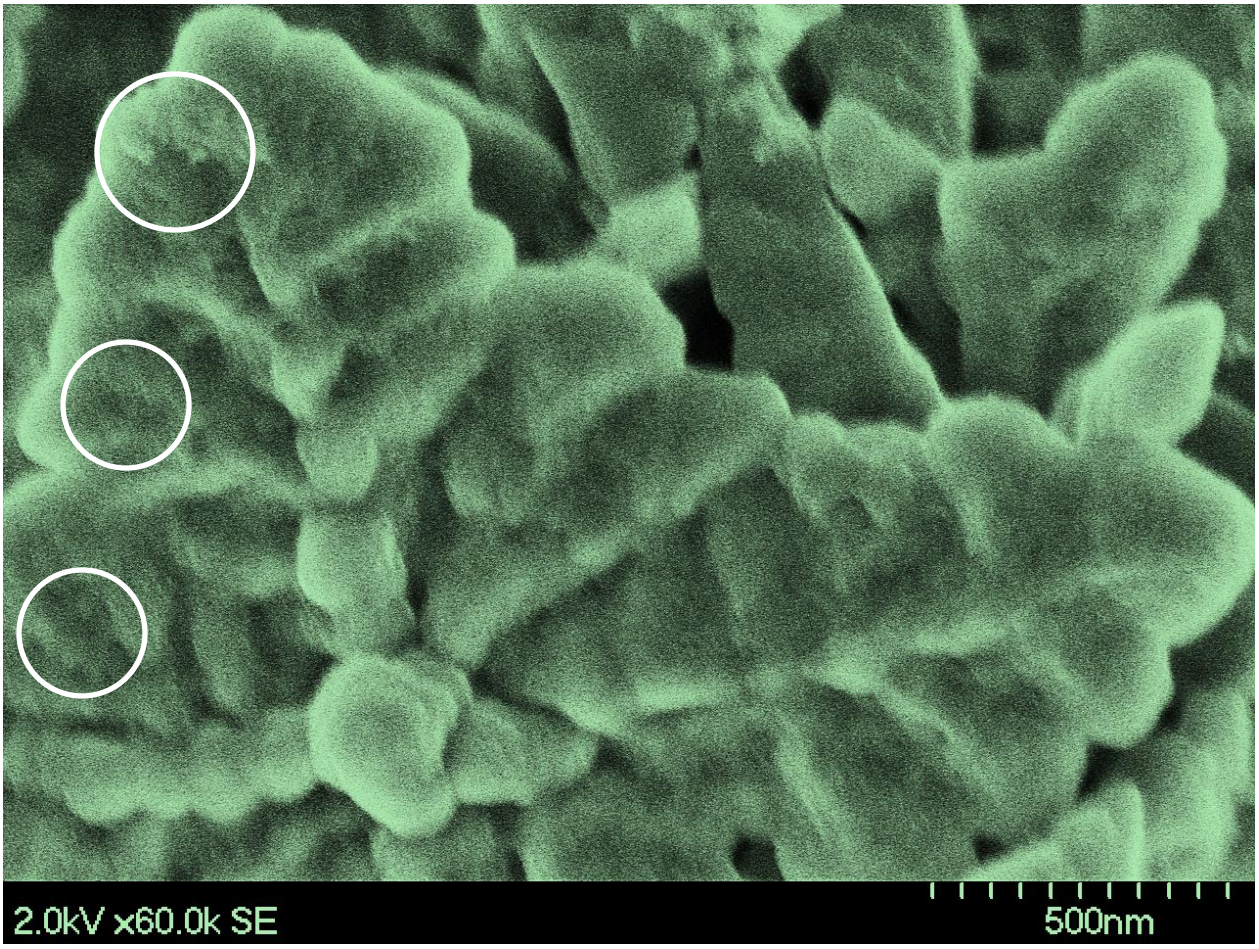

Fig. S1. SEM images of Sn/Co on Sn/Sn clovers at 10% loading. The typically smooth Sn/Zn clovers (see Fig. S9b) are decorated with very small nanoparticles of Sn/Co material (Fig. S9e) most obvious in the upper left region of this image.

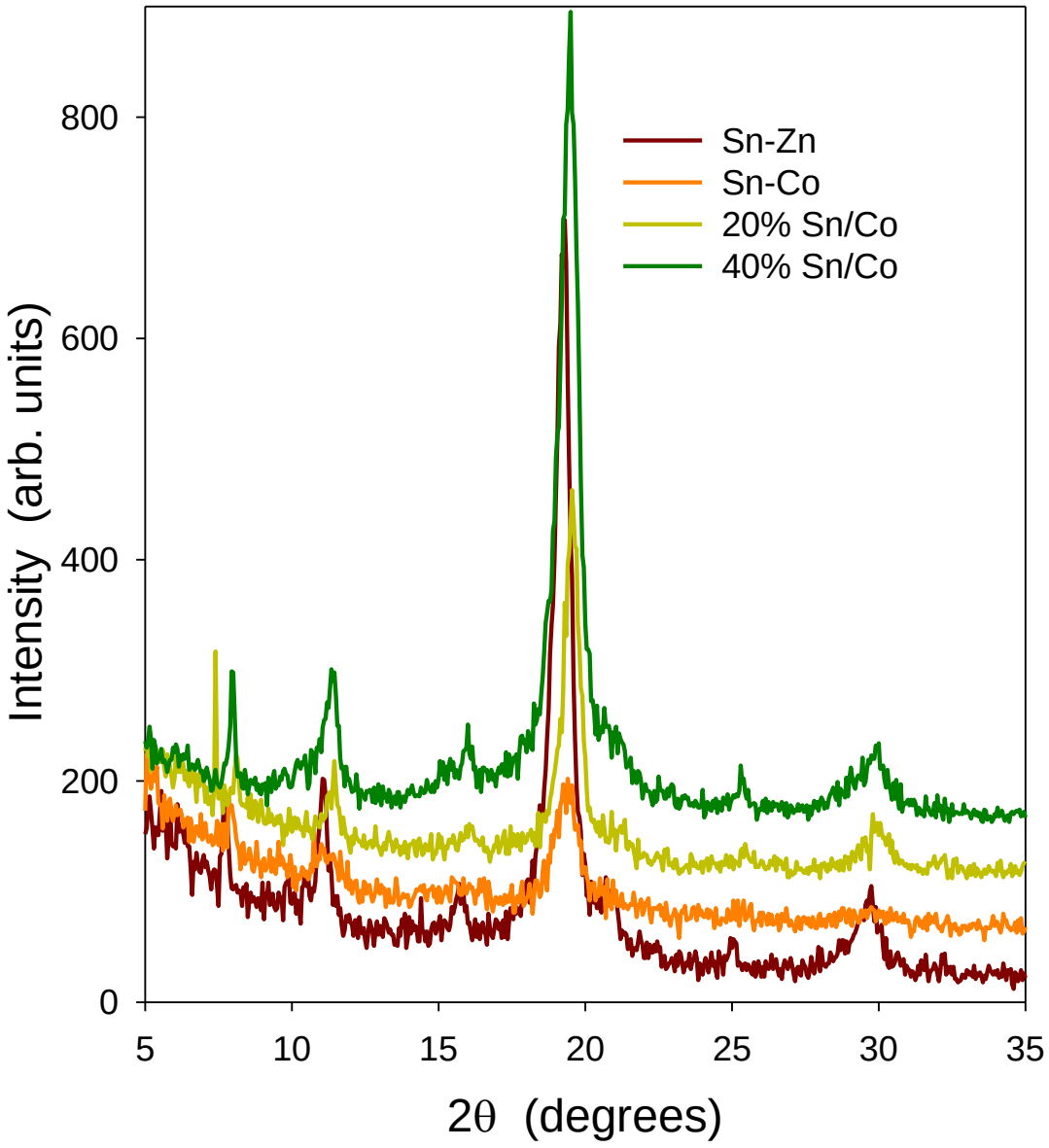

Fig. S2. XRD patterns of the Sn/Zn clovers, Sn/Co clovers, and the 20% Sn/Co on Sn/Zn clovers and 40% Sn/Co on Sn/Zn hybrid structures. The angles for the reflections in the XRD patterns are given in **Table S1**. Notice that the angles for the Sn/Co-Sn/Zn hybrids are greater than for the Sn/Zn clovers for the peaks at 7.72°, 19.23°, 20.88°, 25.04°, and 29.63°. Since the reflections of the Sn/Co clovers are also at higher angles the upshifts for the hybrids are likely due to the presence of the Sn/Co nanoparticles on the surface. However, the upshifts are generally larger than for the Sn/Co clovers possibly indicating strain in the Sn/Co solid particles. Some small shifts may also be a result of difference in dryness of the samples although the drying time was the approximately the same for all samples.

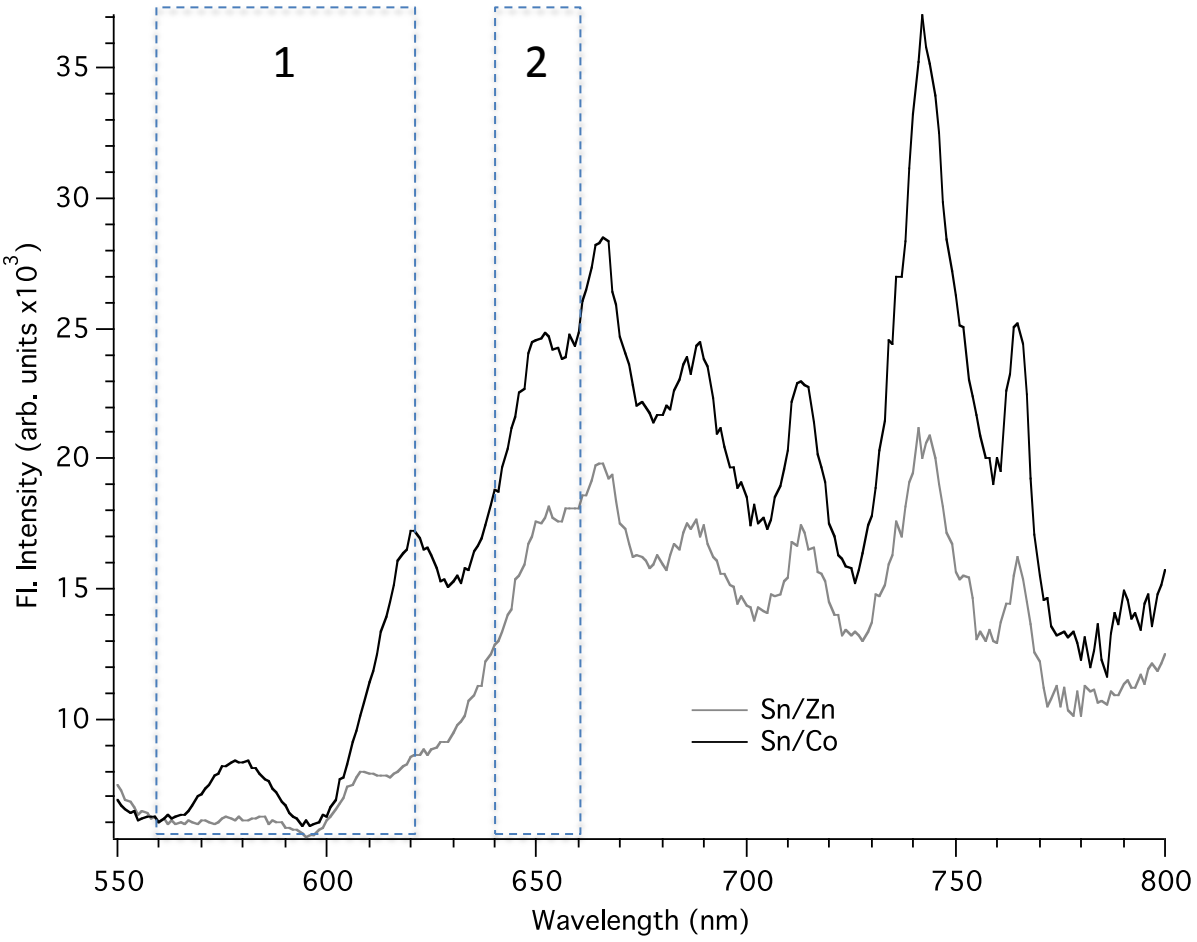

Fig. S3. Fluorescence emission spectra for Sn/Zn and Sn/Co clovers suspended in ethanol excited at 515 nm. The two boxes denote the regions for Ch. 1 and Ch. 2 used in the fluorescence microscopy data collection.

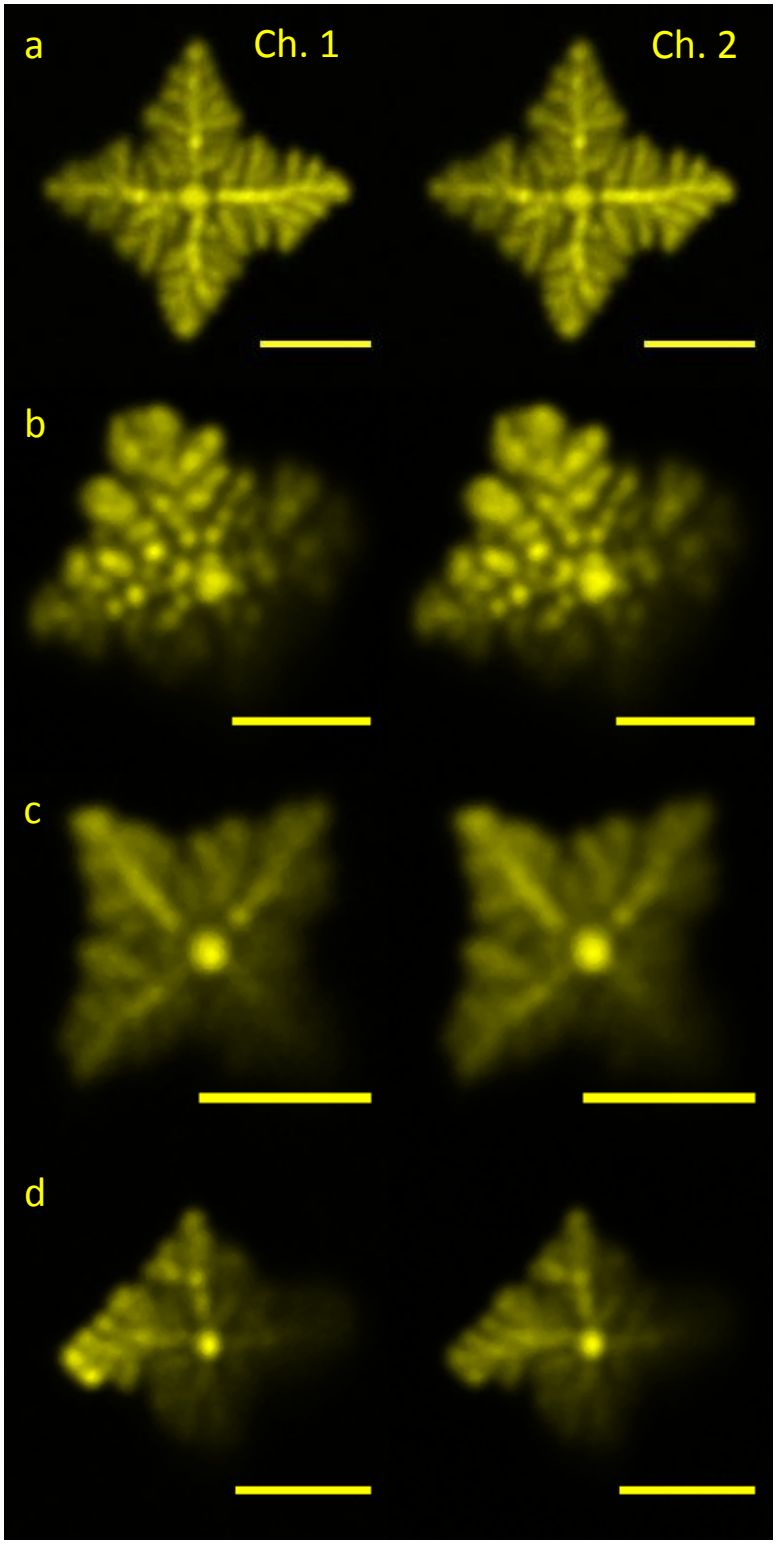

Fig. S4. Normalized fluorescence microscopy images of single clovers and Sn/Co-Sn/Zn nanocomposites. Ch. 1 is 560-620 nm and Ch. 2 is 640-660 nm. (a) Sn/Zn, (b) Sn/Co, (c) 20% Sn/Co-Sn/Zn, and (d) 40% Sn/Co-Sn/Zn. Scale bars are all 2 μm.

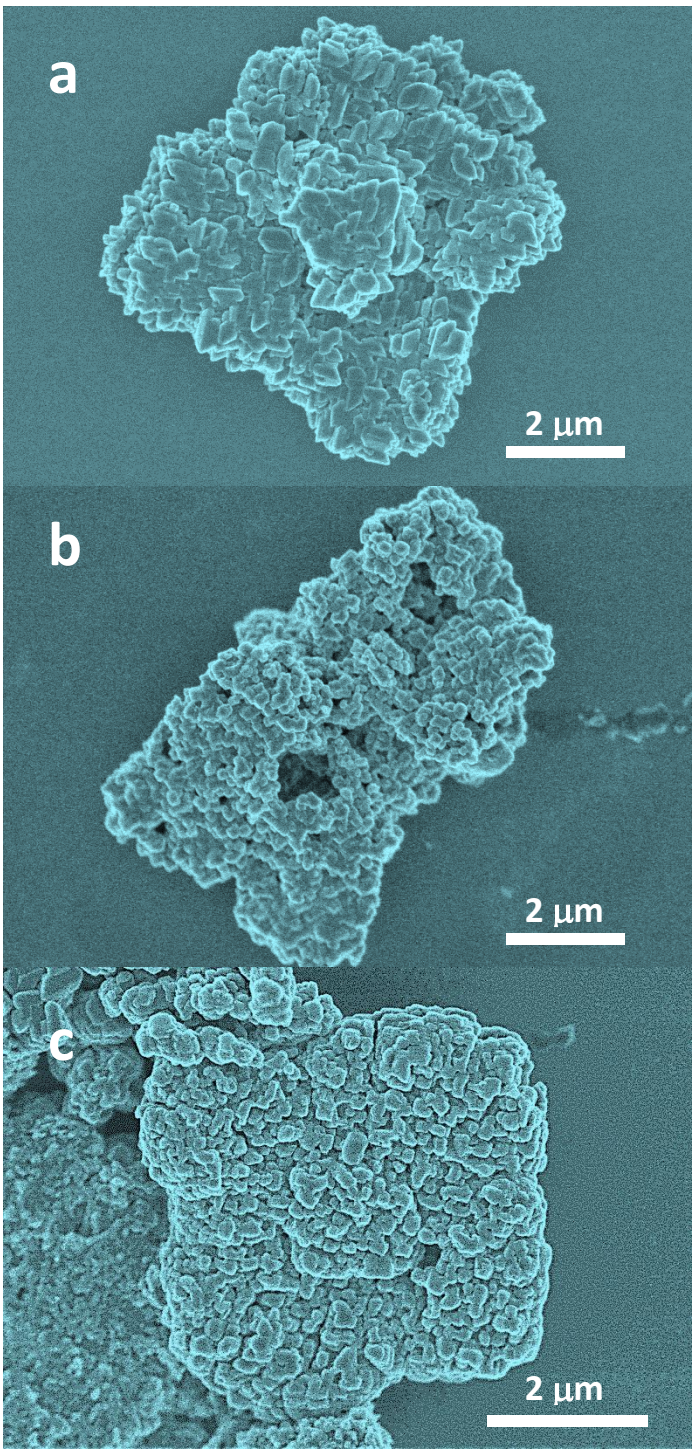

Fig. S5. SEM images of Sn/Co on Sn/Sn clovers at 10% (a), 20% (b), and 40% (c) loading. The structures have the shape of the Sn/Sn clovers (Fig. S9d) with a texture progressively closer to the Sn/Co clovers (Fig. S9e) at high loadings.

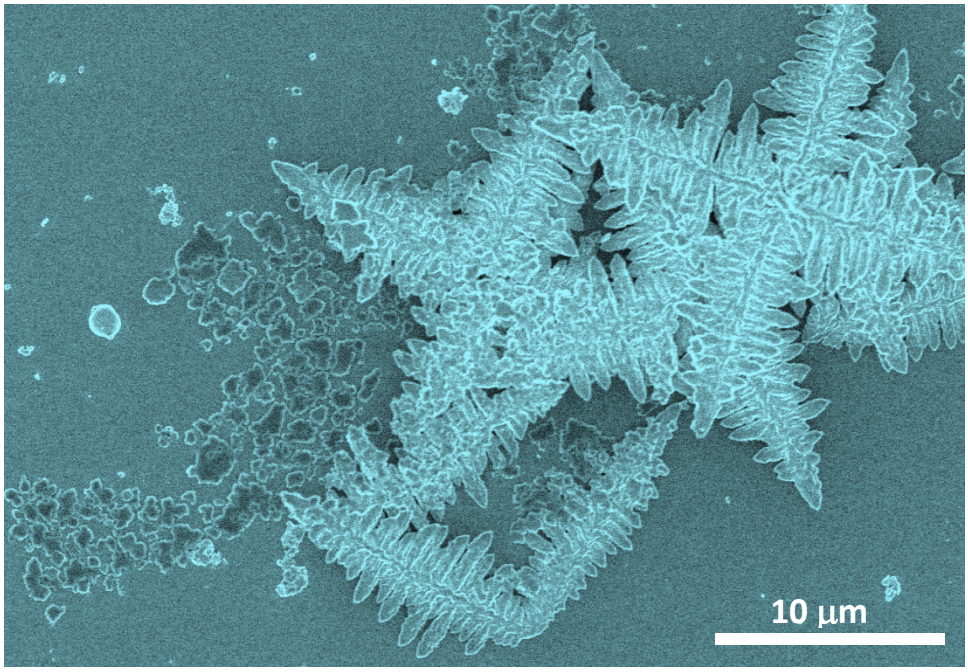

Fig. S6. SEM image of Zn/Co on Zn/Zn clovers with 20% loading shows phase separation rather than growth on the clovers. The Zn/Zn clovers are unchanged from those in Fig. S9c, and the dark material on the Si wafer is similar to the Zn/Co clovers in Fig. S9f.

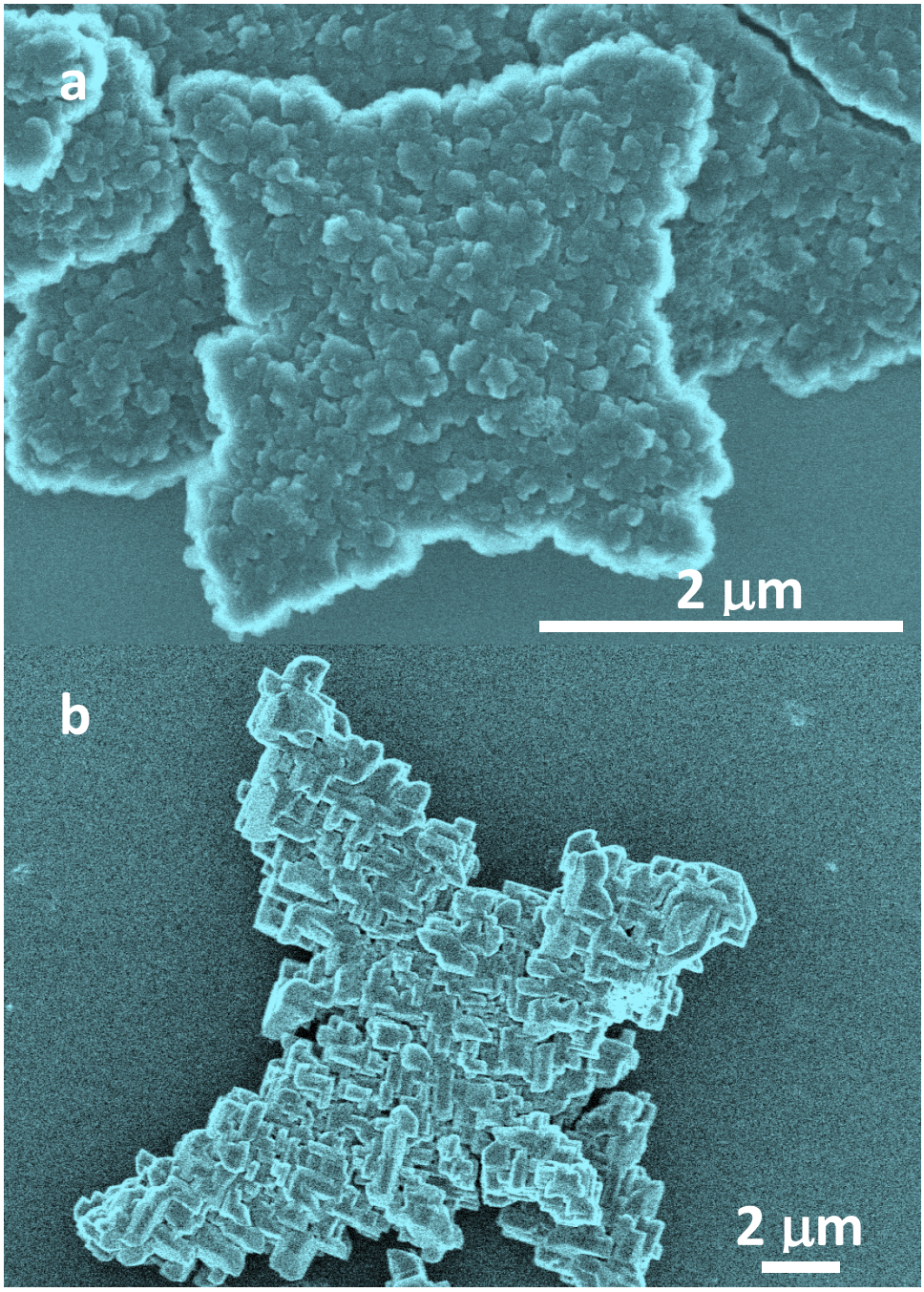

Fig. S7. SEM images of Sn/Sn on Zn/Sn clovers at 20% (a) and 40% (b) Sn/Sn coverage. At 20% (a), the shape is similar to the Zn/Sn clovers with a texture that resembles the Sn/Sn clovers in Fig. S9d. At 40% (b), the texture is even more similar to the Sn/Sn clovers.

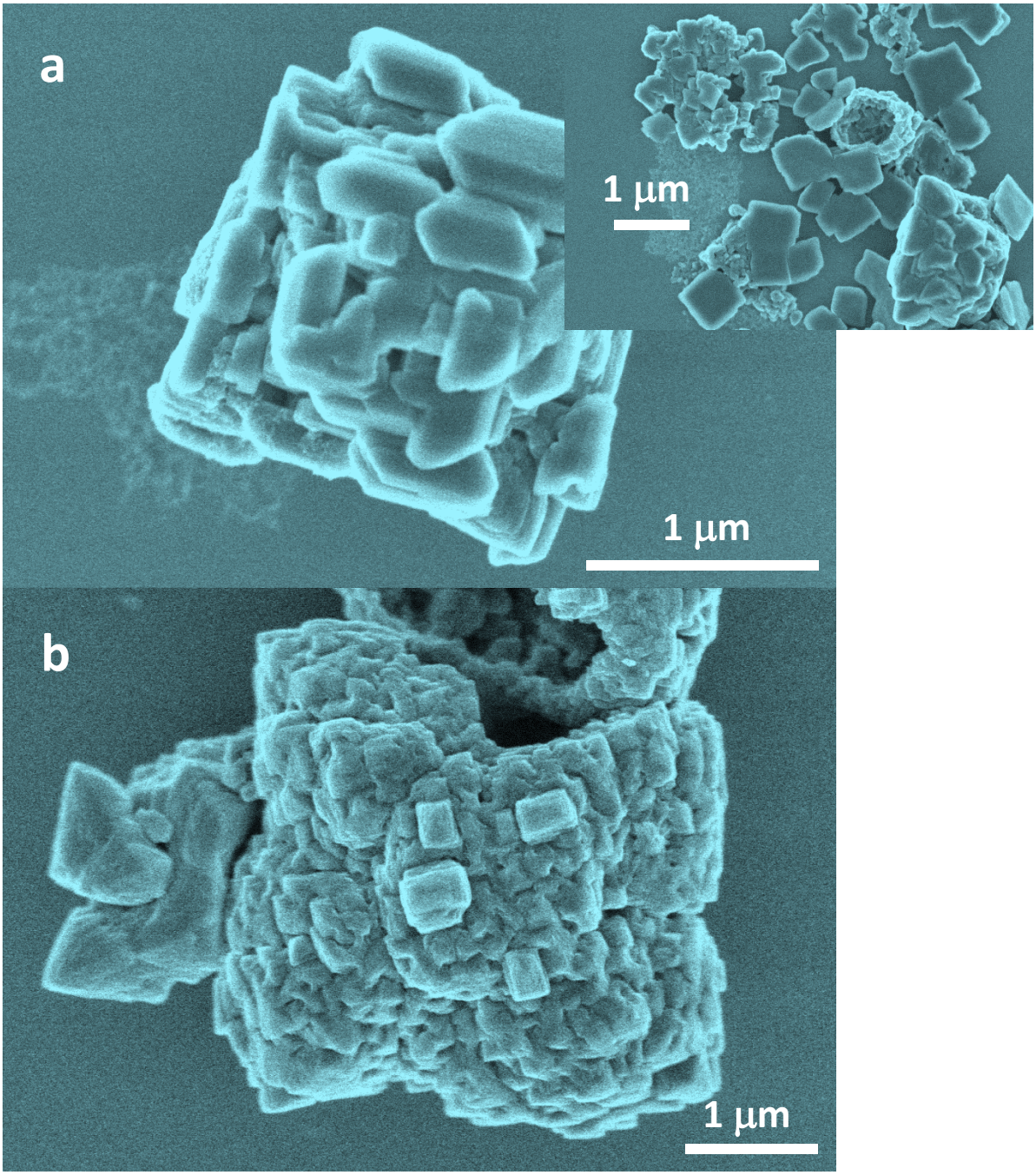

Fig. S8. SEM images of Zn/Sn on Sn/Sn clovers at 20% (a) and 40% (b) Zn/Sn loading. Clover-like structures are similar to the Sn/Sn clovers at pH 5. Inset: phase separation appears to occur (shown for 20% case) with structures resembling both the Zn/Sn clovers (Fig. S9a) and the Sn/Sn clovers (Fig. S9d).

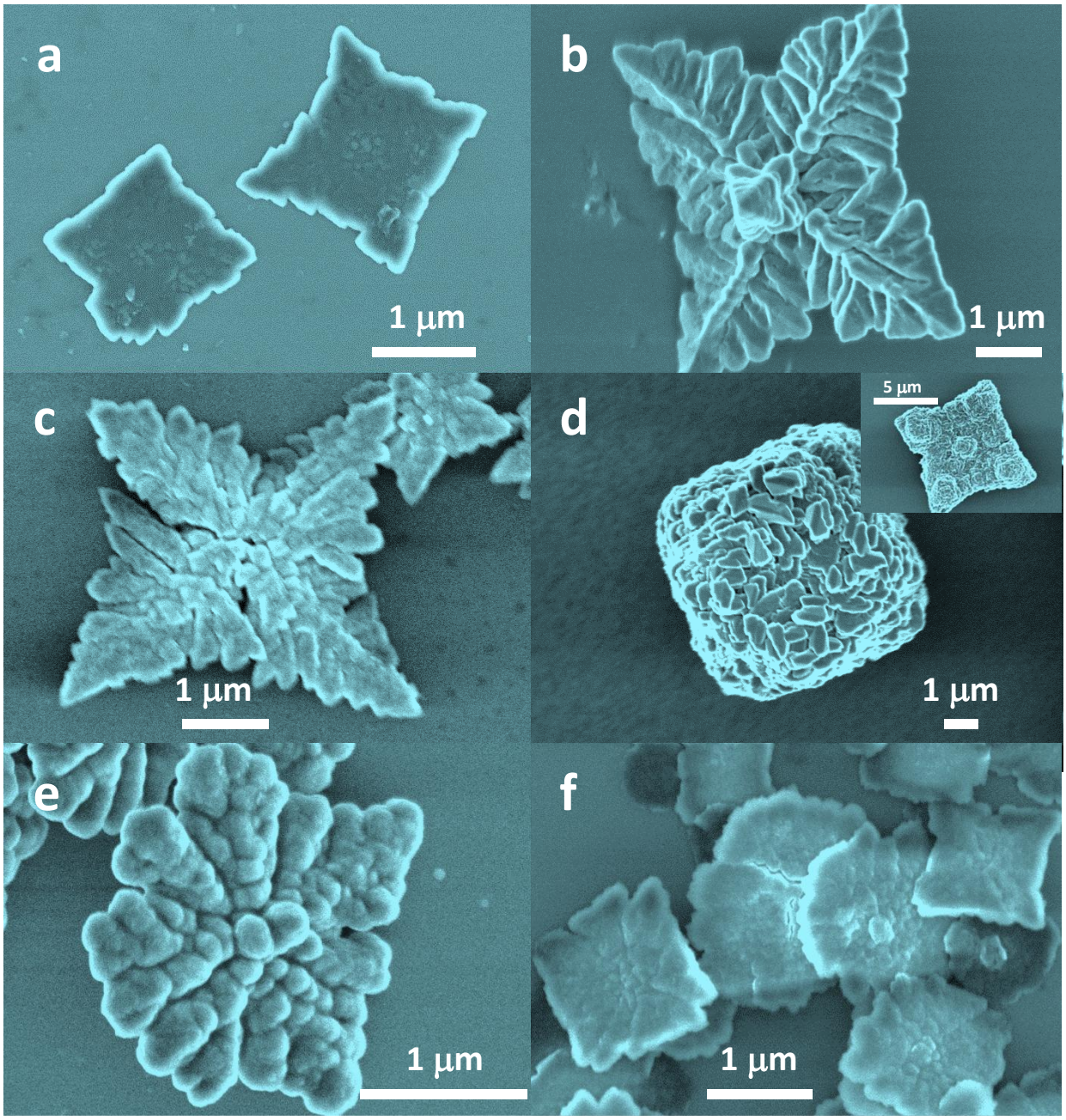

Fig. S9. SEM images of (a) Zn/Sn, (b) Sn/Zn, (c) Zn/Zn, (d) Sn/Sn, (e) Sn/Co, and (f) Zn/Co clovers. Inset in (d) is a slightly different clover-like morphology that coexists in the sample.