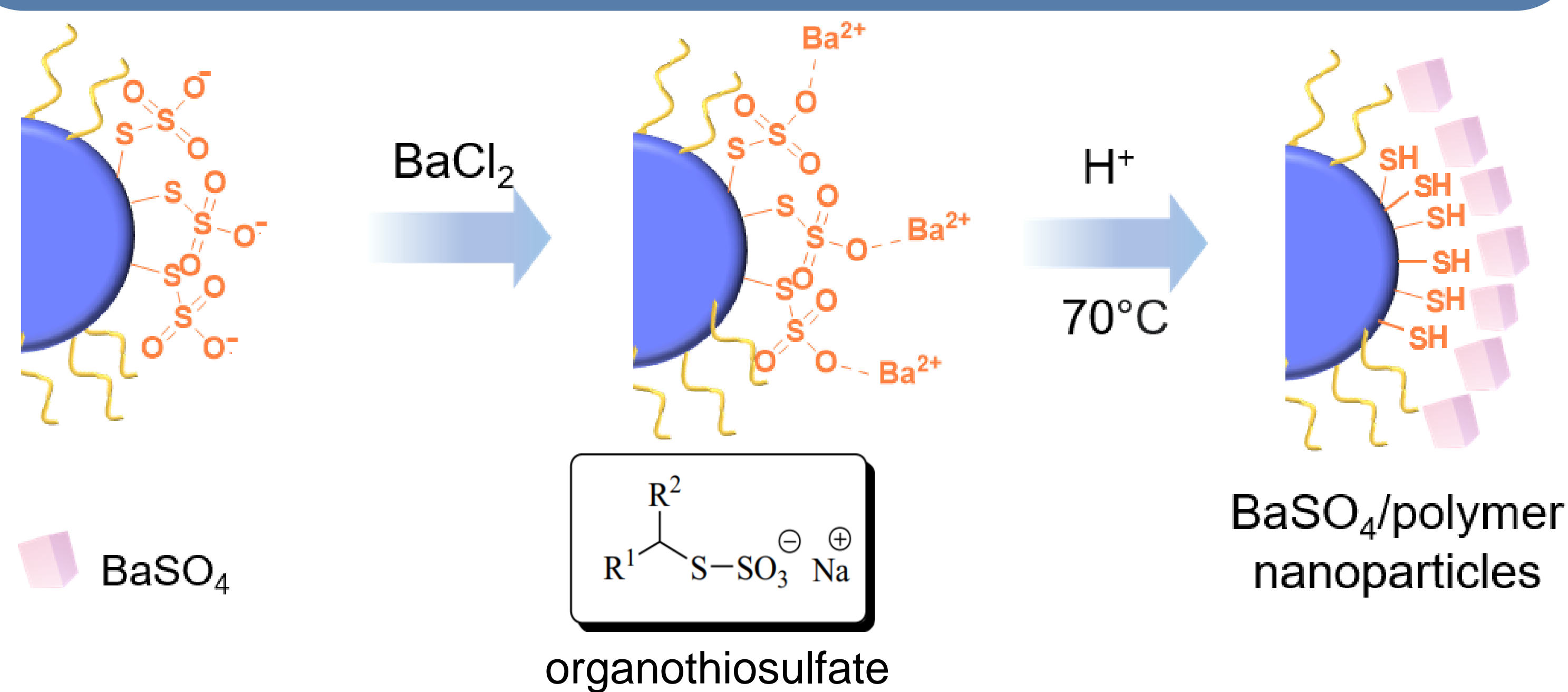


1 Challenge

Barium sulfate suspensions are common contrast agents for X-ray imaging. Despite their importance, they suffer from low colloidal stability. Herein, we show that BaSO₄/polymer hybrid nanoparticles can be obtained by surface-induced crystallization of BaSO₄ crystals on polymer functionalized with thiosulfate groups. The X-ray attenuation coefficient of barium sulfate/polymer hybrid nanoparticles was 121 HU which was significantly larger than the attenuation coefficient of soft tissues.

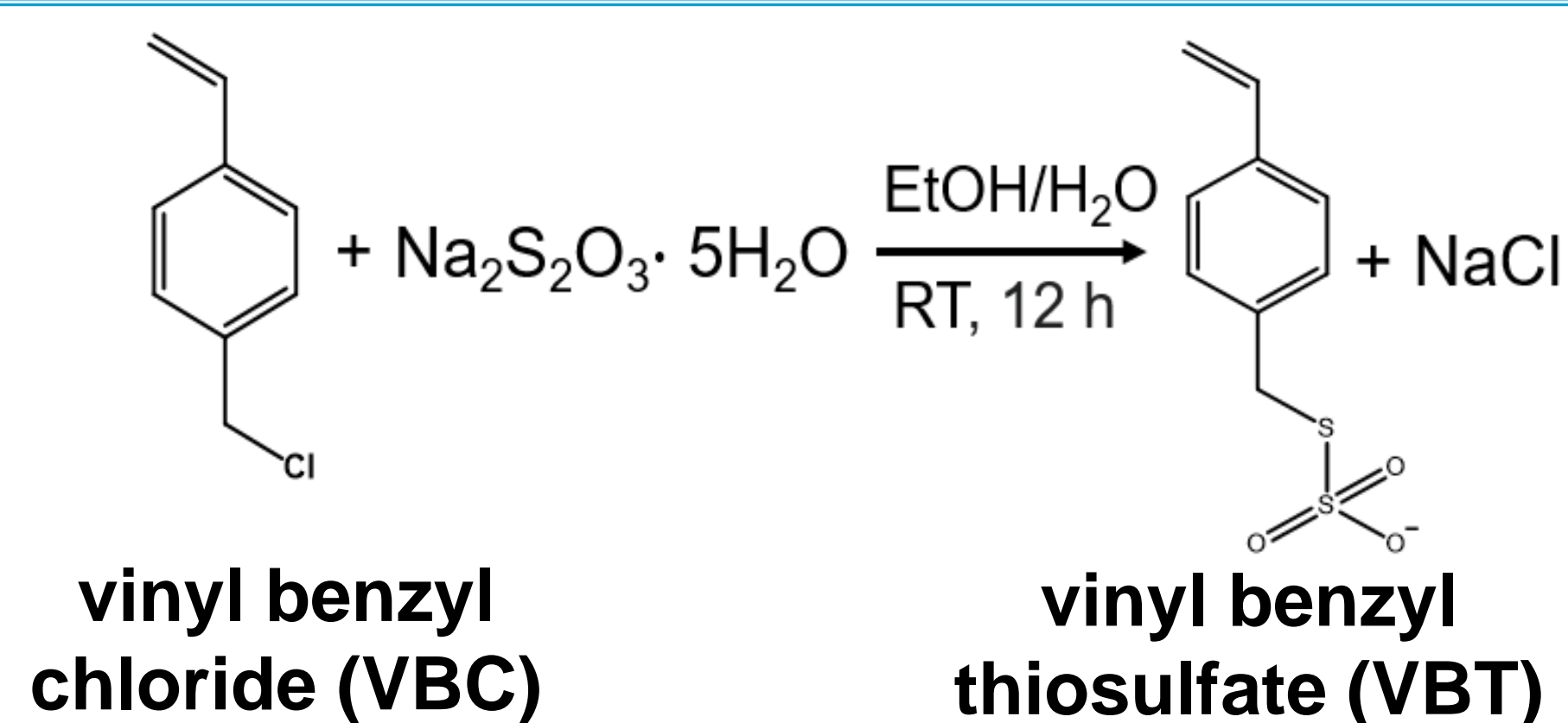
2 Concept



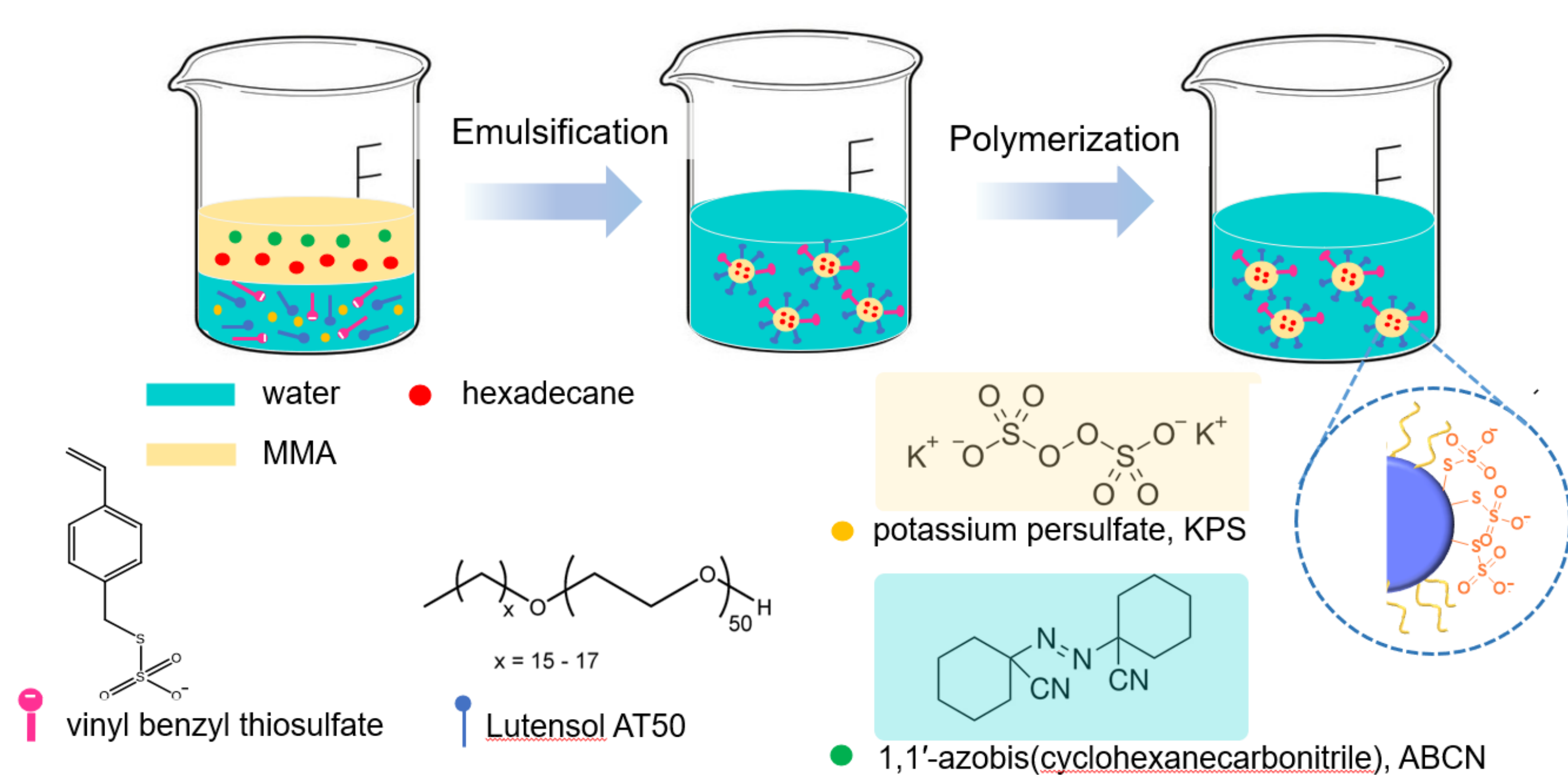
Hydrolysis of thiosulfate-functionalized nanoparticles to produce sulfate ions reacting with Ba²⁺ in dispersion

3 Synthesis of thiosulfate-functionalized nanoparticles

Synthesis of polymerizable Bunte salt (VBT)



Miniemulsion copolymerization



Thiosulfate-functionalized particles

Entry	Monomer unit in copolymer [mol%]		<i>D_h</i>		Solid content (wt%)	ζ-potential (mV)
	MMA	VBT	[nm]	PDI		
VL134-10	100	0	138	0.150	0.7	-30
VL134-0	90	10	169	0.129	1.0	-44
VL131-1	96	4	162	0.109	2.4	-58
VL134-6	87	13	234	0.288	3.1	-72

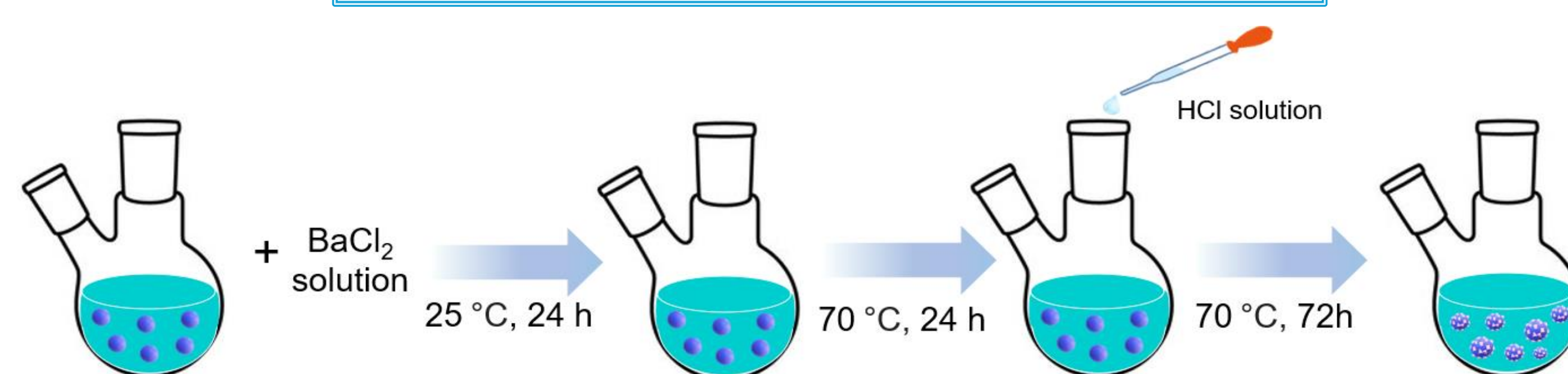
Control of thiosulfate functionalization

Increasing of VBT concentration

Diameter and zeta potential ↗

4 Synthesis of BaSO₄/polymer nanoparticles

Hydrolysis of thiosulfate moieties



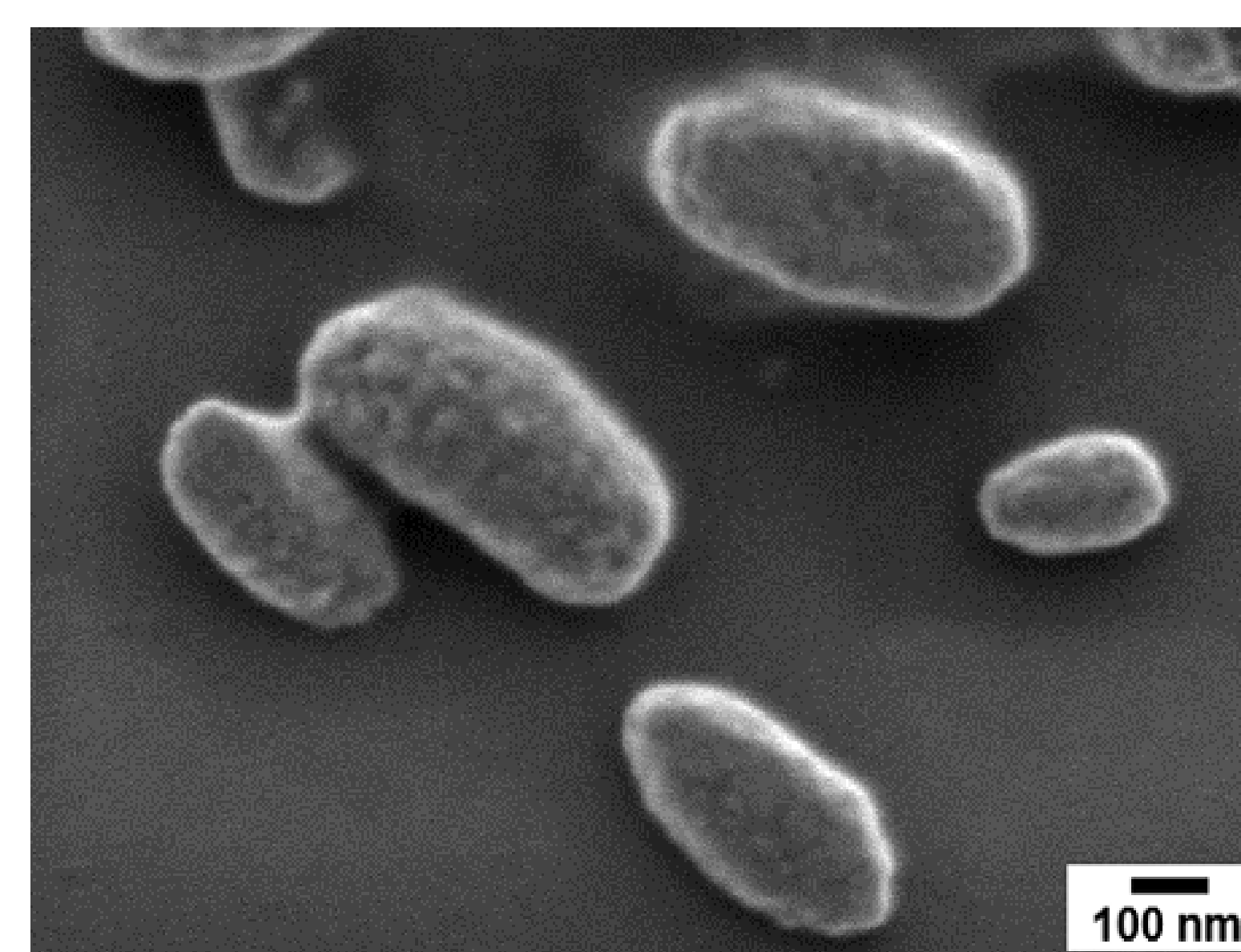
BaSO₄/polymer nanoparticles

Entry	Feed ratio [mol]		<i>D_h</i>		ζ-potential (mV)	Ba in dispersion (mg Ba/L)	Ba in polymer (mg Ba/mg polymer)
	VBT	BaCl ₂	[nm]	PDI			
VL134-0.2Ba	1.0	0.2	105	0.397	-36	1.7	0.106
VL134-0.5Ba	1.0	0.5	125	0.307	-35	2.6	0.046
VL134-1.0Ba	1.0	1.0	151	0.395	-33	4.6	0.198

Increasing barium concentration

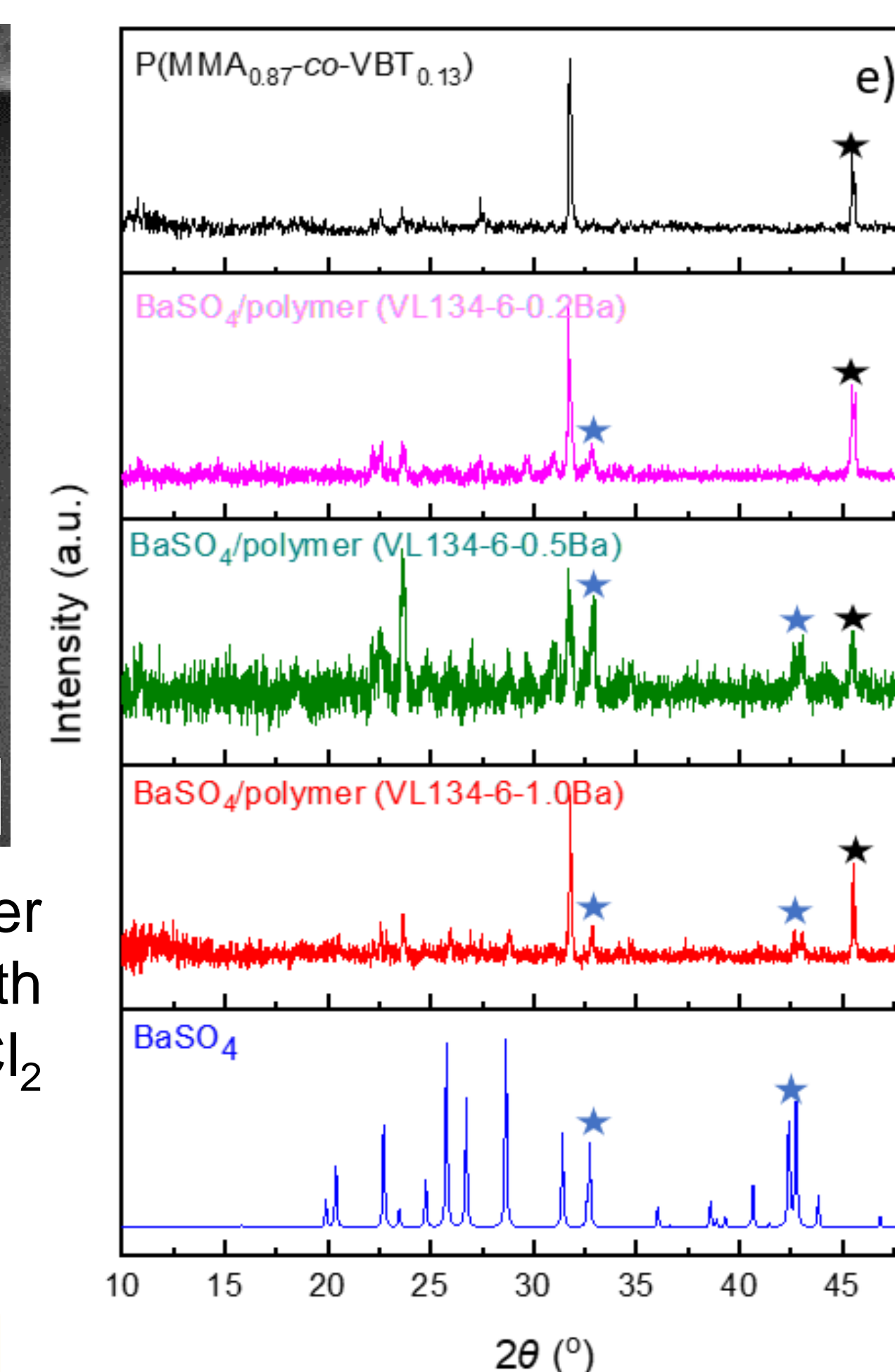
Hydrodynamic diameter ↗

SEM



Micrograph of barium sulfate/polymer nanoparticles after filtration prepared with a molar ratio between VBT units and BaCl₂ of 2

X-ray diffraction



XRD patterns of barium sulfate, barium sulfate/polymer nanoparticles prepared with VBT units to BaCl₂ ratios

Presence of BaSO₄ on nanoparticle surface

5 Conclusions

- Successful synthesis of thiosulfate-functionalized nanoparticles by miniemulsion copolymerization
- Crystallization of BaSO₄ on nanoparticle surface
- The X-ray attenuation coefficient of barium sulfate/polymer hybrid nanoparticles was 121 HU