

### Low-temperature wet chemistry synthetic approaches towards ferrites

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**Table S1: Examples of hydrothermal synthesis of BiFeO<sub>3</sub>**

Precursors	Mineraliser and Other Additives	Temperature/Time [other conditions]	Crystal Form	Notes	Reference
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	10 M KOH	194 °C / 2 hours [microwave]	agglomerated microcrystals		1
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	4 M KOH	200 – 220 °C / 2.5 – 20 hours	submicron	Bi <sub>2</sub> Fe <sub>4</sub> O <sub>9</sub> Bi <sub>25</sub> FeO <sub>40</sub> competing at higher pH	2
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	5 M NaOH H <sub>2</sub> O <sub>2</sub>	200 °C	spindles 500 nm	Bi <sub>12</sub> Fe <sub>0.63</sub> O <sub>18.945</sub> Bi <sub>2</sub> Fe <sub>4</sub> O <sub>9</sub> depending on pH and metal ratio	3
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	~11 M KOH 1.3 M Na <sub>2</sub> CO <sub>3</sub>	180 °C/ 30 minutes [microwave]	nanocubes 50–200 nm		4
NaBiO <sub>3</sub> ·nH <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	KOH [K]/[Bi] = 120–240	180 °C/ 48 hours	0.1 × 0.1 × 0.1 mm <sup>3</sup>	Bi <sub>12.5</sub> Fe <sub>0.5</sub> O <sub>19.5</sub> and Bi <sub>2</sub> Fe <sub>4</sub> O <sub>9</sub> competing phases	5
		180 °C/ 7 days	0.5 × 0.5 × 0.5 mm <sup>3</sup>		
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	4 M KOH triethanolamine	130 °C / 24 hours	spherical ~ 100 nm diameter	triethanolamine lowers reaction temperature needed	6
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	8 M KOH	160 °C / 28 hours	‘walnut-like’ micro-spheres <i>ca</i> 30 μm	Bi <sub>25</sub> FeO <sub>40</sub> at longer reactions times	7
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O	12 M KOH	200 °C / 24 – 48 hours	‘nanoflakes’ 100–200 nm diameter		8

$\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	$\text{KNO}_3$				
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	8 M KOH	200 °C / 3 – 24 hours	Microspheres: agglomerates of primary particles	Electronic band gap and magnetism correlated to crystal morphology	9
	12 M KOH		microcubes		
	12 M KOH polyethylene glycol		submicrocubes		
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	8 M KOH	175 - 225 °C / 6 hours	agglomerates of irregular-shaped particles 10 -100 nm		10
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	NaOH $\text{HNO}_3$ polyvinylpyrrolidone/ethanol	180 °C / 6 hours	agglomerated nanoparticles in 1 $\mu\text{m}$ diameter microrods		11
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	1 – 9 M KOH	200 °C / 12 hours	shape evolution from sphere to octahedron, truncated octahedron, cubo-octahedron or truncated cube		12
$\text{Bi}(\text{NO}_3)_3$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	4 M KOH	180 °C / 1 hour [microwave]	intergrown submicron crystals		13
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	polyvinylalcohol/HCl 7 M KOH	180 °C / 24 hours	150 nm particles	$\text{Bi}_{25}\text{FeO}_{40}$ formed at shorter reaction times or lower temperatures	14
		140 °C 6 hours			
$\text{BiCl}_3$ $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$	1 – 5 M NaOH $\text{NH}_4\text{Cl}$	140 - 200 °C / 6 hours	agglomerates – irregular cubes	addition of $\text{NH}_4\text{Cl}$ influences purity and crystallinity	15
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$	4 – 7 M KOH	200 °C / 4 hours	agglomerates – cubes > 10 $\mu\text{m}$ with increasing KOH concentration		16
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	2N $\text{HNO}_3$ 8 M KOH	200 °C / 6 hours [4 - 12 T magnetic field]	irregular cubes, linked to give chains	magnetic field influences crystallite morphology	17
$\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	4 – 12 M KOH $\text{Na}_2\text{CO}_3$	160 – 200 °C / 30-60 mins [2.45 GHz	agglomerates of submicron cuboids	$\text{Na}_2\text{CO}_3$ lowered temperature required and adjusted crystal morphology	18

		microwave]			
BiCl <sub>3</sub> FeCl <sub>3</sub>	5.7 - 20 M KOH surfactant (PEG, EDTA, CTAB, PVP)	180 °C /6 hours	irregular micron-sized agglomerates, becoming cuboid at higher pH	effect of surfactant is not significant	19
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	6 – 10 M NaOH	180 °C /up to 24 hours	> 10 μm cuboids	Bi <sub>2</sub> Fe <sub>4</sub> O <sub>9</sub> and Bi <sub>25</sub> FeO <sub>40</sub> observed in competition	20
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	7 M KOH acetone	130 °C / 12 hours	cubic particles with the size range from 50 to 200 nm	acetone lowers temperature of synthesis and avoids formation of Bi <sub>12</sub> (Bi <sub>0.5</sub> Fe <sub>0.5</sub> )O <sub>19.5</sub>	21
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	3 M KOH ethylene glycol	120 –140 °C /12 hours	agglomerates to give spherical microstructure with diameter ~ 10 μm		22
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	8 M KOH 2-methoxy ethanol	200 °C /10 hours	agglomerated nanorods length between 15 and 20 nm and diameter of ~ 2–3 nm.		23
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O FeCl <sub>3</sub> ·6H <sub>2</sub> O	NH <sub>4</sub> OH pH = 12-13 acetone	200 °C /48 hours	nanorods: 100 nm × 1 μm length		24
Bi(NO <sub>3</sub> ) <sub>3</sub> ·5H <sub>2</sub> O Fe(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	9 M KOH hexadecyl trimethyl ammoniumbromide	180 °C for 90 min [microwave]	agglomerated faceted crystals in 10 μm microspheres		25

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