

TABLE OF CONTENTS

	Page
ANKNOWLEDGEMENT	iii
ABSTRACT (ENGLISH)	v
ABSTRACT (THAI)	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
ABBREVIATIONS AND SYMBOLS	xxii
CHAPTER 1 INTRODUCTION	1
1.1 Metal Tungstates and Molybdates	4
1.1.1 Application of Metal Tungstates and Molybdates	4
1.1.2 Structure of Metal Tungstates	4
1.1.3 Structure of Metal Molybdates	6

1.2 Electrospinning method	7
1.3 Microwave method	13
1.4 Hydrothermal/Solvothermal method	14
1.5 Microwave- Hydrothermal method	17
1.6 Research objectives	19
CHAPTER 2 LITERATURE REVIEW	20
2.1 Synthesis of metal tungstates and metal molybdate	20
CHAPTER 3 EXPERIMENTAL PROCEDURE	30
3.1 Chemical reagents, equipments and instruments	30
3.1.1 Chemical reagents	30
3.2. Synthesized methods	32
3.2.1 Synthesis of SrWO ₄ using electrospinning	32
3.2.2 Synthesis of MgWO ₄ using electrospinning	34
3.2.3 Synthesis of MgMoO ₄ using electrospinning	36
3.2.4 Synthesis of SrMoO ₄ using Microwave-Hydrothermal	37
3.3. Characterization	39

CHAPTER 4 RESULTS AND DISCUSSION	47
4.1. SrWO ₄ synthesized by electrospinning method	47
4.2. MgWO ₄ synthesized by electrospinning method	68
4.3. MgMoO ₄ synthesized by electrospinning method	82
4.4. SrMoO ₄ synthesized by microwave-hydrothermal method	95
C HAPTER 5 CONCLUSION	115
5.1 SrWO ₄ by electrospinning	114
5.2 MgWO ₄ by electrospinning	114
5.3 MgMoO ₄ by electrospinning	115
5.4 SrMoO ₄ by microwave-hydrothermal	115
R EFERENCES	117
APPENDICES	129
APPENDIX A	130
APPENDIX B	153
CURRICULUM VITAE	154
INTERNATIONAL PUBLICATIONS	

LIST OF TABLES

Table	Page
3.1 Product codes of the present research MgWO_4 .	35
3.2 Product codes of the present research MgWO_4 .	37
3.3 Product codes of the present research SrMoO_4 .	38
4.2 Lattice parameters and crystallite sizes of the MW5C1, MW5C2 and MW5C3 products.	70

LIST OF FIGURES

Figure	Page
1.1 Crystal structure of SrWO ₄	5
1.2 MgWO ₄ cell unit	5
1.3 Crystal structure of SrMoO ₄	6
1.4 MgMoO ₄ cell unit	7
1.5 Schematic diagram to show polymer nanofibers by electrospinning.	9
1.6 PLLA nanofibers with different diameters and pores	10
1.7 AFM image of electrospun PEO nanofibers with beads	11
1.8 SEM photographs of electrospun nanofibers from different polymer concentration solutions	11
1.9 SEM photographs of PEO nanofibers electrospun under different electrical potentials	12
1.10 Potential applications of electrospun polymer nanofibers.	13
1.11 General purpose autoclave popularly used for hydrothermal synthesis	15
1.12 Pressure temperature map of materials processing techniques	16
3.1 Schematic diagram used for preparation of SrWO ₄	33

3.2	Schematic diagram of electrospinning equipment	34
3.3	Schematic diagram of Microwave-Hydrothermal equipment.	39
3.4	Thermogravimetric analyzer	40
3.5	X-ray diffractometer	41
3.6	Fourier transform infrared spectroscope	42
3.7	Raman spectroscope	43
3.8	Field emission-scanning electron microscope and Scanning electron microscope	43
3.9	Transmission electron microscope	44
3.10	Luminescence spectrometer	45
3.11	UV-Vis-NIR Spectrophotometer.	46
4.1.1	TGA curves of a spider's web synthesized from the M4 solution, and PVA.	48
4.1.2	XRD patterns of SrWO ₄ -PVA spider's web, synthesized from the M4 solution, after calcination at 300 °C, 400 °C, 500 °C and 600 °C for 3 h.	50
4.1.3	FTIR spectra of (a) PVA, and (b)–(f) SrWO ₄ -PVA spider's web, synthesized from the M4 solution, before and after calcination at 300 °C, 400 °C, 500 °C and 600 °C for 3 h.	53

- 4.1.4 Raman spectrum of SrWO₄ spider's web, synthesized from the M4 solution, after calcination at 600 °C for 3 h. 55
- 4.1.5 SEM image of the product prepared using PVA 1.0 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M1). 56
- 4.1.6 SEM image of the product prepared using PVA 1.1 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M2). 57
- 4.1.7 SEM image of the product prepared using PVA 1.2 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M3). 57
- 4.1.8 SEM image of the product prepared using PVA 1.3 g, Sr(C₂H₃O₂)₂, And H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M4). 58
- 4.1.9 SEM image of the product prepared using PVA 1.3 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M4), calcined at 300 °C for 3 h. 58
- 4.1.10 SEM image of the product prepared using PVA 1.3 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M4), calcined at 400 °C for 3 h. 59
- 4.1.11 SEM image of the product prepared using PVA 1.3 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M4), calcined at 500 °C for 3 h. 59
- 4.1.12 SEM image of the product prepared using PVA 1.3 g, Sr(C₂H₃O₂)₂, and H₂₆N₆O₄OW₁₂·xH₂O as starting reagents (Sample code M4), calcined at 600 °C for 3 h. 60

- 4.1.13 TEM and HRTEM images, of SrWO₄-PVA spider's web, 61
synthesized from the M4 solution, after calcination at
(a and b) 500 °C for 3 h.
- 4.1.14 SAED and simulated patterns, TEM images and SAED of 62
SrWO₄-PVA spider's web, synthesized from the M4 solution,
after calcination at (a and b) 500 °C, and (c and d) 600 °C
for 3 h.
- 4.1.15 TEM images and SAED of SrWO₄-PVA spider's web, 63
synthesized from the M4 solution, after calcination at (a and b)
600 °C for 3 h.
- 4.1.16 (a) and (b) Distributions of fibrous diameters and particle sizes 64
of the SrWO₄-PVA spider's web, synthesized from the M4
solution, before and after calcination at 600 °C for 3 h,
respectively.
- 4.1.17 The $(\alpha h\nu)^2$ versus $h\nu$ plot of the SrWO₄ spider's web, 65
synthesized from the M4 solution.
- 4.1.18 PL spectra of SrWO₄-PVA spider's web, synthesized from the 67
M4 solution, after calcination at 300 °C, 400 °C, 500 °C and
600 °C for 3 h.
- 4.2.1 XRD spectra of the MW5C1, MW5C2 and MW5C3 products, 69
compared with the anorthic and monoclinic MgWO₄ phases, after
calcination at 500 °C, 600 °C, and 700 °C for 3 h respectively

- 4.2.2 Simulated XRD pattern and crystal structure of monoclinic MgWO_4 (Sample code MW5C3), after calcination $700\text{ }^\circ\text{C}$ for 3 h. 71
- 4.2.3 SEM image of the product MW1 solution, the product prepared using $1.5\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 0.9 g as starting reagents. 72
- 4.2.4 SEM image of the product MW2 solution, the product prepared using $1.5\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.1 g as starting reagents. 73
- 4.2.5 SEM image of the product MW3 solution, the product prepared using $1.5\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents. 73
- 4.2.6 SEM image of the product MW3C1 solution, the product prepared using $1.5\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at $500\text{ }^\circ\text{C}$ for 3 h. 74
- 4.2.7 SEM image of the product MW4 solution, the product prepared using $3.0\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents. 74
- 4.2.8 SEM image of the product MW4C1 solution, the product prepared using $3.0\text{ mmol } (\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at $500\text{ }^\circ\text{C}$ for 3 h. 74

- 4.2.9 SEM image of the product MW5 solution, the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents. 75
- 4.2.10 SEM image of the product MW5C1 solution, the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 500 °C for 3 h. 76
- 4.2.11 SEM image of the product MW5C2 solution, the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 600 °C for 3 h. 76
- 4.2.12 SEM image of the product MW5C3 solution, the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{W}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 700 °C for 3 h. 77
- 4.2.13 TEM and HRTEM images of the MW3C1 (a and b), (c and e) of the MW5C1 calcination at 500 °C for 3 h. 78
- 4.2.14 TEM and HRTEM images of the MW3C1 calcination at 500 °C for 3 h (a), (b-d) of the MW5C1 calcination at 500 °C for 3 h. 79
- 4.2.15 PL emission of the MW5C1, MW5C2 and MW5C3 products, and calcination at 500 °C, 600 °C, and 700 °C for 3 h respectively. 80
- 4.2.16 UV–visible absorption of the MW5C3 product calcination at 700 °C for 3 h. 81
- 4.2.17 The $(\alpha h\nu)^{1/2}$ versus $h\nu$ plot of the MgWO_4 , synthesized from the MW5C3 calcination at 700 °C for 3 h. 82

- 4.3.1 TGA curves of PVA and the MgMoO_4 -PVA, synthesized from the 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents (Sample code MM3). 83
- 4.3.2 XRD spectra of the MgMoO_4 fibrous webs, synthesized from the 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 500 °C, 600 °C, and 700 °C for 3 h respectively. 85
- 4.3.3 SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 0.7 g as starting reagents (Sample code MM1). 87
- 4.3.4 SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.0 g as starting reagents (Sample code MM2). 87
- 4.3.5 SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents (Sample code MM3). 88
- 4.3.6 SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 400 °C for 3 h (Sample code MM3C1). 88
- 4.3.7 SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g as starting reagents and calcination at 500 °C for 3 h (Sample code MM3C2). 89

4.3.8	SEM image of the product prepared using 4.5 mmol $(\text{CH}_3\text{COO})_2\text{Mg}\cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$, and PVA 1.3 g, as starting reagents and calcination at 600 °C for 3 h (Sample code MM3C3).	89
4.3.9	TEM and HRTEM images of the MM3 fibrous webs, after calcination at (a and b) 500 °C for 3 h.	90
4.3.10	TEM and HRTEM images of the MM3 fibrous webs, after calcination at (a and b) 600 °C for 3 h.	91
4.3.11	FTIR spectra of PVA and the MMC3 fibrous webs before and after calcination at 400, 500 and 600 °C for 3 h.	92
4.3.12	Raman spectrum of the MMC3 fibrous web after calcination at 600 °C for 3 h.	94
4.3.13	UV-visible absorption of the MMC3 fibrous web, after calcination at 600 °C for 3 h.	95
4.4.1	XRD patterns of (a) MSA1, MSA2 and MSA3, the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 5, 15, and 30 min respectively.	97
4.4.2	XRD patterns of MSB1, MSB2 and MSB3, of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 5, 15, and 30 min respectively.	98

- 4.4.3 XRD patterns of MSC1, MSC2 and MSC3, the product prepared using 5.0 mmol $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 5, 15, and 30 min respectively. 99
- 4.4.4 Simulated XRD pattern and crystal structure of SrMoO_4 , the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min. 100
- 4.4.5 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 5 min (Sample code MSA1). 101
- 4.4.6 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 15 min (Sample code MSA2). 101
- 4.4.7 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min (Sample code MSA3). 102
- 4.4.8 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 90 min (Sample code MSA4). 102
- 4.4.9 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 90 min (Sample code MSA4). 103

- 4.4.10 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, 103
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 5 min (Sample code MSB1).
- 4.4.11 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, 104
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 15 min (Sample code MSB2).
- 4.4.12 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, 104
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 15 min (Sample code MSB2).
- 4.4.13 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, 105
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 30 min (Sample code MSB3).
- 4.4.14 SEM image of the product prepared using 5.0 mmol $\text{Sr}(\text{CH}_3\text{CO}_2)_2$, 105
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 30 min (Sample code MSB3).
- 4.4.15 SEM image of the product prepared using 5.0 mmol $\text{SrCl}_2\cdot 6\text{H}_2\text{O}$, 106
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 5 min (Sample code MSC1).
- 4.4.16 SEM image of the product prepared using 5.0 mmol $\text{SrCl}_2\cdot 6\text{H}_2\text{O}$, 106
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-
hydrothermal for 15 min (Sample code MSC2).

- 4.4.17 SEM image of the product prepared using 5.0 mmol $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min (Sample code MSC3). 107
- 4.4.18 (a, b) TEM and HRTEM images, and (c, d) SAED and simulated patterns of image of the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min (Sample code MSA3). 108
- 4.4.19 Schematic illustration for the formation of hierarchical architecture of SrMoO_4 109
- 4.4.20 Raman spectra of the MSA3, MSB3 and MSC3 products, the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 5, 15, and 30 min respectively. 111
- 4.4.21 UV-visible absorption of the MSC3 product, the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min. 112
- 4.4.22 the $(\alpha h\nu)^2$ vs $h\nu$ plot of the MSC3 product, the product prepared using 5.0 mmol $\text{Sr}(\text{NO}_3)_2$, and $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ as starting reagents and a 270 w microwave-hydrothermal for 30 min. 113

ABBREVIATIONS AND SYMBOLS

°C = Degree Celcius

mm = Millimeter

nm = Nanometer

µm = Micrometer

Å = Angstrom

mg = Milligram

ml = Milliliter

EDS = Energy Dispersive X-ray Spectroscopy

FT-IR = Fourier-Transform Infrared Spectrometry

PL = Photoluminescence Spectrometry

SEM = Scanning Electron Microscopy

TEM = Transmission Electron Microscopy

XRD = X-Ray Diffraction Spectrometer

JCPDS = The Joint Committee for Powder Diffraction

Standards