

Synthesis and Analysis of Anthracene –Lead Titanate composites by Solid State Method

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Abstract:

The composition of Anthracene and Lead Titanate is prepared using Solid State method. Anthracene is a solid poly cyclicaromatic hydrocarbon(PAH)of formula $C_{14}H_{10}$,consisting of three fused benzene rings. It is a component of coal tar. Lead (II) titanate is an inorganiccompound with the chemical formula $PbTiO_3$. It is the lead salt of titanicacid. Lead(II)Titanate is a yellow powder that is insoluble in water. At high temperatures, lead Titanate adopts a cubic perovskite structure. The samples of Anthracene –Lead Titanate composites of suitable mixture are prepared using Solid state method. Crystal structure of thecalcinedpowdersandalssinteredceramicswereanalysedusingXRD(X-raydiffraction).Themicrostructure of the sintered ceramics has been investigated using SEM (scanning electronmicroscopy).

Key Words: Anthracene, Lead Titanate, dielectric properties, SEM, Atomic percent, EDX. Solid State Method, Perovskite, PAH, Pelletization, Sintering, Morphology.

I. INTRODUCTION

One of the most important are as of opportunity in material sciences today is field of functional materials[1]. In this paper we discuss about the composition of Anthracene and Lead Titanate is prepared using Solid State method[2]. Data of dielectric properties of Lead Titanate ceramic compositions near the Rhombohedral-Tetragonal phase boundary. These Anthracene is a solid polycyclic aromatic hydrocarbon (PAH) of formula $C_{14}H_{10}$, consistingof three fused benzene rings. It is a component of coal tar. Lead (II) Titanate is basically an inorganic compound which appearsas yellow powder that is insoluble in waterwiththe chemical formula $PbTiO_3$. It isthe lead salt of titanic acid.. At high temperatures, Lead Titanate adopts a cubic perovskite structure. The samples of Anthracene-Lead Titanate

Composites of suitable mixture ratio are prepared using solid state method and analyzed by characteristic studies for Grain size from SEM and atomic percent from EDX.

II. SOLID STATESYNTHESISPROCESS

Solid State Synthesis method is a process in which molecules bound covalently on a solidsupportmaterial. Theyaresynthesized step-by-step in a single reaction vessel utilizing selective process [2]. Initially it starts with weighing precursor in a stoichiometric amount. Then the sample material is grinded for about 8hrs with the help of motor pestle cinated. The mixture was then dried in a hot air oven. The grinded powder sample is then calcinated at 750°C for 4hrs using a heating rate of $2^{\circ}\text{C}/\text{min}$ in order to initiate the formation of the perovskite phase. The calcined powder was then pressed into pelletized under the load of 5 tons and sintering the pellets was done at 370°C for 8 hours. Phase formation investigation was done with X-ray diffraction using a diffractometer.

III. STRUCTURALSTUDY

At high temperatures, lead Titanate was observed to adopt a cubic perovskite structure [3] as shown in Fig1 and Fig2. The size of the particle and its morphology is shown in Figure [3-5] shows the SEM micrographs of the calcined ceramic powder. The particle size of the calcined powder was observed to increase with the Zr content, which is in line with the results from particle size analysis. The calcined PbTiO_3 ceramic powder observed to have a spherical morphology whereas the other compositions possess polyhedral morphology [4]. Scanning electron microscopy is used to determine the grain size of the materials.

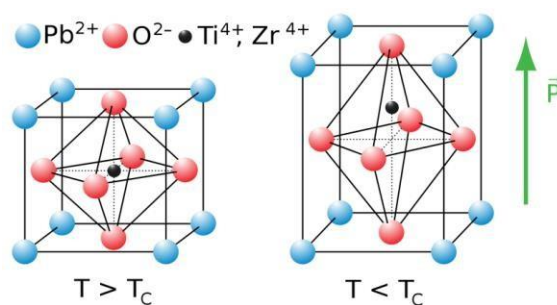


Fig:1

IV. CHARACTERIZATION RESULTS.

The morphology and the grain structure of the sample is shown in the below figures taken from scanning Electron microscope. SEM results are shown in the below Fig2 to 5.

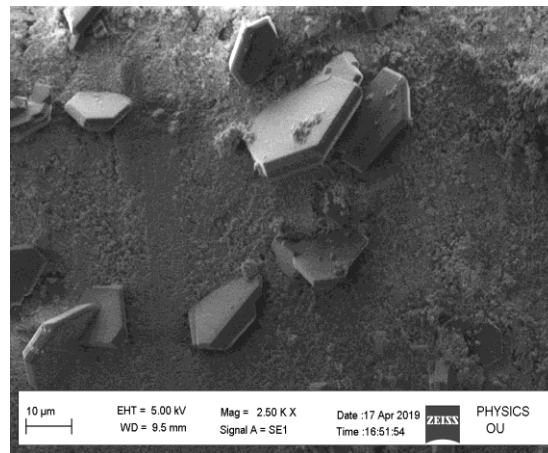


Fig.:2

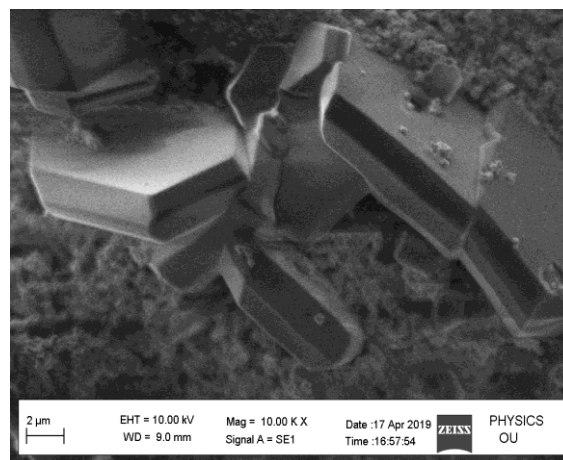


Fig.:3

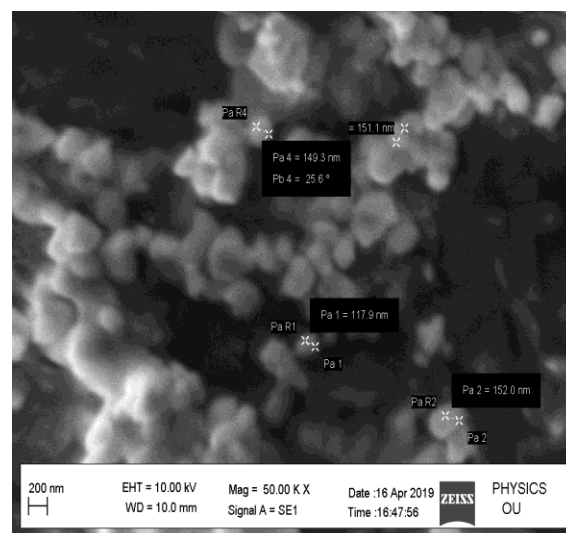


Fig.:4

V RESULTS AND DISCUSSION

The average grain size of Prepared Anthracene –Lead Titanate composites of suitable mixture ratio using Solid State Method is found to be 142.55nm as shown in the above Fig 3-5. The material is observed to have particle size in nanometer range and with low impurities. The atomic percentages are shown in the below table.

Table 1

Element	Theoretical	Experimental
Lead	4.54	4.73
Titanium	3.64	3.73
Oxygen	21.84	21.97
Anthracene	68.99	69.57
TOTAL	99.01	100

Table 2. The mass percentages

Element	Theoretical	Experimental
Lead	43.05	41.78
Titanium	9.94	7.62
Oxygen	9.97	14.98
Anthracene	34.94	35.62
TOTAL	99.97	100

EDAX Spectrum processing:

No peaks omitted

Processing option: All elements analyzed (Normalised) Number of iterations = 1

Standard:

C CaCO₃

O SiO₂

Pb PbF₂

Table3

Element	Weight%	Atomic%
CK	35.62	69.57
OK	14.98	21.97
TiK	7.62	3.73
PbM	41.78	4.73
Totals	100.00	

Spectrum processing:

No peaks omitted

Processing option: All elements analyzed (Normalized)

Number of iterations =1

Standard:

C CaCO₃

O SiO₂

Ti Ti

Pb PbF₂

Element	Weight%	Atomic%
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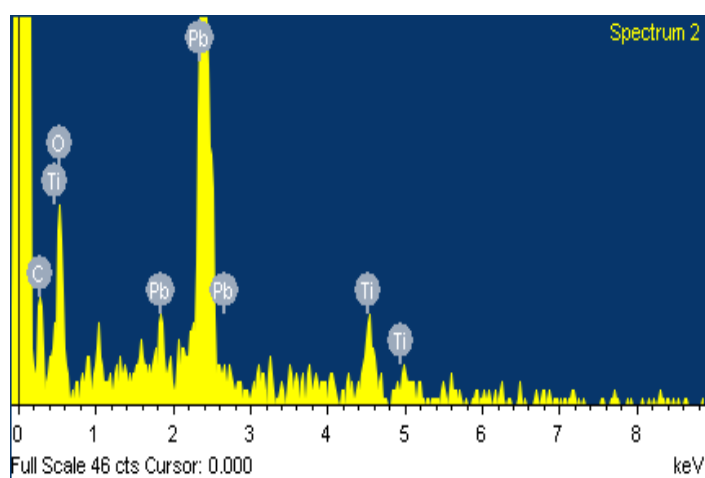
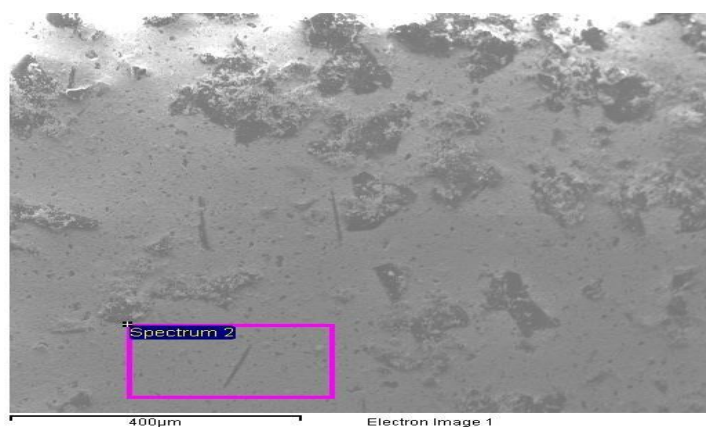


Fig: 5 Presence of Pb, Ti, C, O

VI CONCLUSIONS

The grain size of given prepared compound Anthracene –Lead Titanate composites of suitable mixture ratio using Solid state method is found to be of 142.55 nm. Atomic and Molecular percentages are determined theoretically and experimentally. The deviation in the experimental and theoretical results is due to the presence of interstitial atoms.

Acknowledgement

The authors would like to thank OU-DST-PURSE - II Programmed for financial support. One of the authors, Potharaju Krishna would like to thank his sincere appreciation to the Department of Physics, Osmania University, Hyderabad, Telangana, India for providing lab and instrumentation facility.

REFERENCES

- [1] “Synthesis and characterization of multi-functional ferrites” AIP Conference Proceedings 2269, 030106 (2020): DOI: 10.1063/5.0019648, Volume 2269, Issue 1, 12 October 2020
- [1] “Piezoelectric Properties of polycrystalline Lead Titanate Zirconate Compositions” D.A. Berlinton, Member, Ire, C. Molik, T. And Hi. Jaffe Senior Member, Ire.
- [2] B. Jaffe, R. S. Roth, and S. Marzullo, "Properties of piezoelectric ceramics in the solid-solution series lead titanate-lead zirconate-lead oxide: tin oxide and lead titanate-lead hafnate," J. Res. Natl. Bur. Standards, vol. 55, pp. 239-254; November, 1955.
- [3] “Preparation and basic properties of PbTiO₃ ferroelectric thin films and their device applications” M. Okuyama & Y. Hamakawa a Faculty of Engineering Science, Osaka University, Toyonaka, Osaka, Japan, online: 08 Feb 2011.
- [4] Nomura, Takabashi H, Nakagawa T; Dielectric and magnetic properties of PbTiO₃. Jpn J. Appl. phys. 7.600-6004 (1968)
- [5] A. Kumar G. L. Sherma J. phys. condense matter 21. (2009)
- [6] Pric, Blinier and Scott. JF mesoscopic model of a system possessing both relaxor ferroelectric and ferromagnetic properties Rev. B. 79; 214114-7p
- [7] Jona F. and Shirane G. 1962 *Ferroelectric Crystals* (New York: MacMillan)
- [8] Migoni R., Bilz H., and Bauerle D. 1976 Phys. Rev. Lett. 37 1155.
- [9] Cross L. E. 1984 Am. Ceramic Soc. Bull. 63 586.
- [10] Sasazawa K., Oshima K. and Yamaoka N. 1987 Jap. J. Appl. Phys. 26 L65.

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