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Preparation of Barium Titanate from Barite Ore of Andhra Pradesh

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Abstract: ***Barium titanate ($BaTiO_3$) is an attractive material in the field of electro ceramics and microelectronics due to its better characteristics. It is having high dielectric constant and low loss characteristics and hence barium titanate is an excellent choice for many applications, such as capacitors, multilayer capacitors (MLCs) and energy storage devices. In the present study an attempt is made to prepare barium titanate from ore using reduction ,leaching ,precipitation and calcinations techniques. The material is giving higher dielectric constant compared to the synthetically prepared materials.***

Keywords: Barium titanate, Barite, Precipitation, Calcination

I. INTRODUCTION

Huge reserves of barite ores are available in Cuddapah region of Andhra Pradesh. Barium titanate is lead freebie, eco-friendly and a piezo-electric material. Owing to topographical provinence, barium titanate merchandise into in to seven key segments. Amidst to aforementioned segments, an agile expansion was recognised from Asia Pacific in comparison to other segments.

Stearic acid and acetic acid gel were utilized in two typical wet synthesis [1]. Barium acetate, tetra butyl titanate, isopropyl alcohol and acetic acid were utilized as dawn reagents in first synthesis with an average powder particle size of 50-80 nm. In the second synthesis barium stearate, tetra butyl titanate and stearic acid acts as dawn reagents. The $BaTiO_3$ nano crystallites with 25-50 nm particle size was obtained from calcination of gel at various temperatures.

For achieving chemical homogeneity over infuse constituent ions-Co-precipitation technique stood as a simple and convenient one. In the interim to milling procedure, solids were obtained from eminent dissipate system by virtue of mechanical action stress fields [2].Using combustion spray pyrolysis $BaTiO_3$ nanoparticles were prepared [3]. Whereas piezoelectric applications, the $BaTiO_3$ synthesis was studied using conventional solid state reaction and other chemical and electrochemical rotes including oxalate co-precipitation route [4-8]. An electrochemical route was opted for synthesizing barium titanate nano particles. Mechanochemical synthesis of barium titanate was made [1] using a mixure of BaO and TiO_2 by using planetary ball mill and zirconium oxide balls in an air atmosphere for 4hrs

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II. MATERIAL AND METHOD

30 gms of Barite ore collected from Kadapa region is mixed with 10 g of activated carbon and roasted at 800^0C for two hours in muffle furnace .After cooling, the material is removed and dissolved in 150 ml of HCl solution by stirring at 500 rpm using Remi stirrer. After stirring the slurry is filtered and the filtrate is barium chloride solution. A mixture of 50 ml- $TiCl_4$ (1M) 50 ml-barium chloride solution was gently added to 50 ml Oxalic acid (2.2 M). The reaction conditions were maintained at 80 ^{0}C in water bath for a period of 15 min. The resultant BariumTetanyl oxalate tetrahydrate [$BaTiO(C_2O_4)\cdot 4H_2O$] was filtered; washed and dried at (90 ^{0}C) for 12 hr. Calcination done by subjecting the material to (850C) for (5 hr) to get BaTiO3 ultrafine powder.

III . RESULT AND DISCUSSION

Barite ore is collected from Mangampet area of Kadapa Region,Andhra Pradesh and the sample is analysed for its elements. The analysis of the barite sample is given in Table1.

Table 1. Barite Analysis

Element	%
Barite	94.72
Si	0.04
Al	0.54
Fe	0.25
Mg	0.048
Co	0.031
Ni	0.0015
Ca	0.07
Ba	55.28

The material has been characterised for its properties using XRD,SEM and AAS. The SEM of barium titanate produced is given in Fig 1.The particle size is less than 2 *m*icrons which is acceptable by the electronic industry.

The XRD and the dielectric constant of the material at different temperatures of 30 and 45^0 C against frequency is given in Figs. 2 and 3 .XRD data confirms the structure of barium titanate and the capacity of the dielectric constant is much higher than the literature value of 1700-2000 at 30^0 C and 1000 HZ.

Barium titanate obtained is analysed for its elements present and the purity of the sample is 99.45 % and the major impurities are Ca,Al and Si.

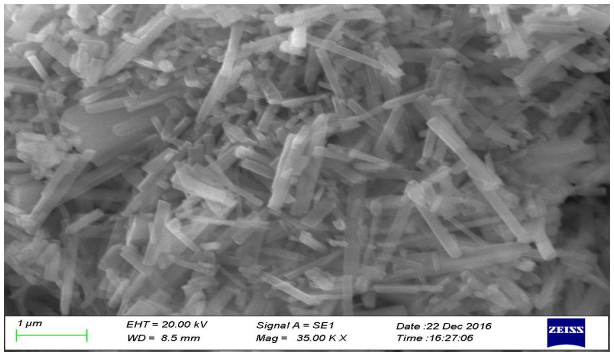

Fig 1. SEM of barium titanate

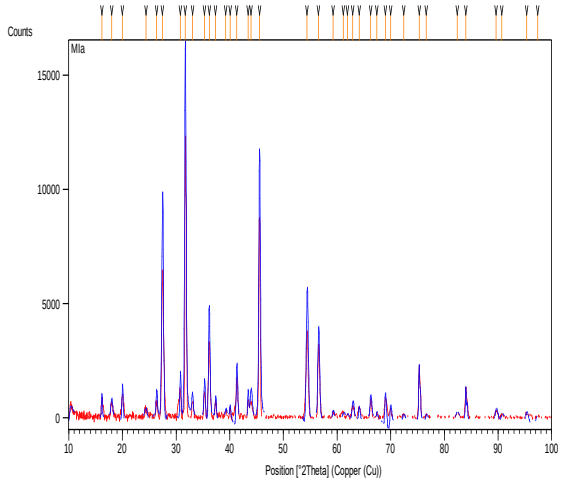

Fig 2. XRD data of the barium titanate

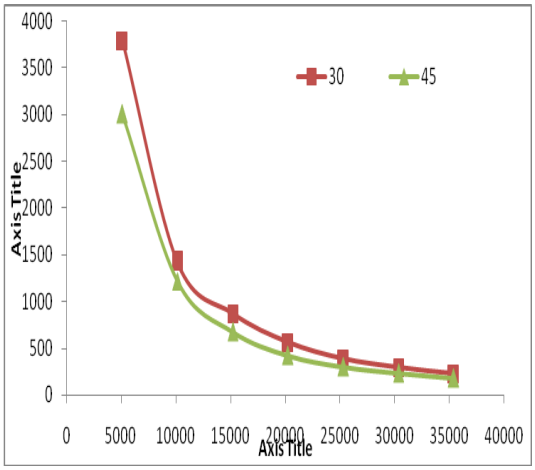

Fig 3. Effect of Dielectric Constant on Frequency and Temperature.

Table 2. Barium Titanate Analysis

Sl. No	Element	Sample 2 %
1	Ba	58.8 %
2	Ti	20.6 %
3	Ni	0.0034
4	Co	0.0019
3	Ca	0.12
4	Si	0.21
5	Al	0.19
6	Fe	0.020
7	Mg	0.007

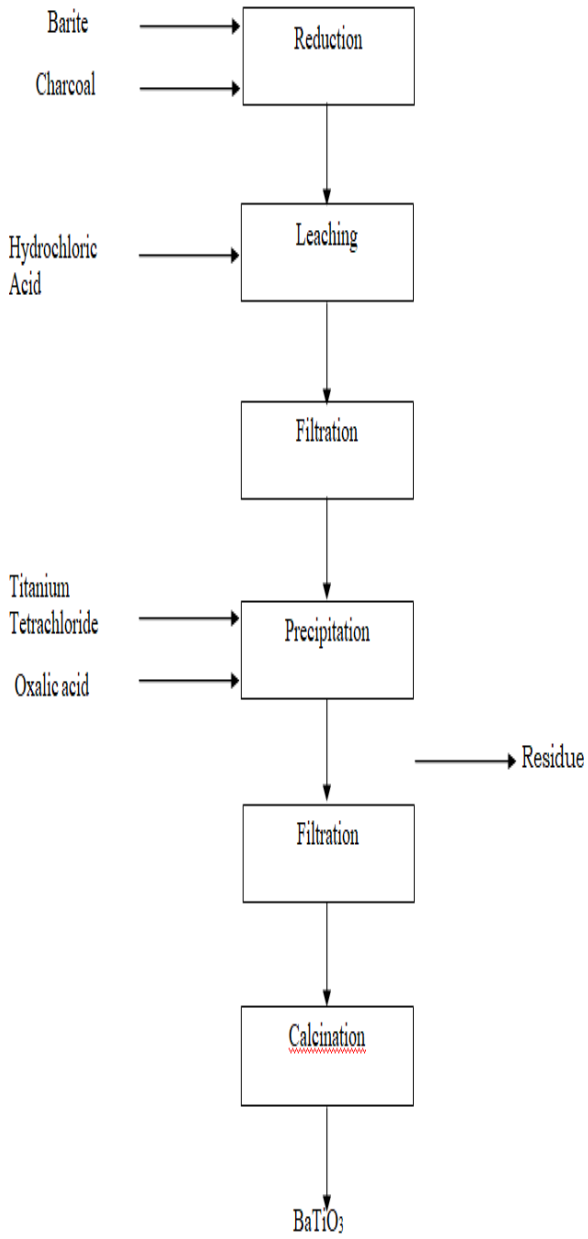

Fig 4. Process Flow Sheet for Barium Titanate Production from Barite Ore

III. CONCLUSIONS

It is possible to produce barium titanate from barite ores of Andhra Pradesh.
The purity of the material is more than 99%
The material Dielectric Constant is more than literature value .
The material is suitable for use in electronic industry.

REFERENCES

1. B. D. Stojanovic, A. Z. Simoes, C. O. Paiva-Santos. C. Jovalekic, V. V. Mitic and J. A. Varela, "Mechanochemical synthesis of barium titanate", J. Eur. Ceram. Soc. 2005, vol. 25, pp. 1985-1989
2. S. Lee, T. Son and Jondoyun, "Preparation of barium titanate nano particles", Materials letters, 2004,vol. 58, pp. 22-23
3. L. S. Seveyrat, Y. Eziane and B. Guiffrad, "Reinvestigation of synthesis of Barium-Titanate conventional solid state reaction and oxalate coprecipitation route for piezoelectric applications" 2005, vol. 440, pp. 35-40, 2005
4. P. R. Kumar,V. Madhusudhanrao, B. N. Rao, M. Venkateswarlu, and N. Satyanarayana "Enhanced electrochemical performance of carbon-coated $LiMPO_4$ (M = Co and Ni) nanoparticles as cathodes for high-voltage lithium-ion battery", Journal of Solid State Electrochemistry,2016,vol. 20, pp. 1855–1863
5. Narsimulu, B.N. Rao, M. Venkateswarlu, E.S Srinadhu, N. Satyanarayana. "Electrical and electrochemical studies of nanocrystalline mesoporous $MgFe_2O_4$ as anode material for lithium battery applications", Ceramics International, 2016, vol. 42(15), pp. 16789- 16797
6. K. Hari Prasad, N. Naresh, Nageswara Rao, M. Venkateswarlu, N. Satyanarayana. "Preparation of $LiMn_2O_4$ Nanorods and Nanoparticles for Lithium-ion Battery Applications", Materials Today: Proceedings,2016, vol. 3(10),pp. 4040-4045
7. M.S. Sudhir, P.M Mohan, R.V. Nadh. "Simple and validated ultraviolet spectrophotometric method for the estimation of Febuxostat in bulk and pharmaceutical dosage forms", Oriental Journal of Chemistry,2013, vol. 29(1), pp. 235-240
8. G. Suresh G., R. Venkata Nadh, N. Srinivasu N, K. Kaushal. "Novel coumarin isoxazoline derivatives:
9. Synthesis and study of antibacterial activities", Synthetic Communications,2016,46(24), pp. 1972-1980

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