
EFFECT OF BaTiO₃ ON UNIT CELL PARAMETER OF Dy₀.₅Li₀.₅TiO₃

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The effect of barium titanate on unit cell parameter of Nd₀.₅Li₀.₅TiO₃ has been reported. The preparation and structural characteristics of Dy₀.₅Li₀.₅TiO₃ and its solid solutions with BaTiO₃ are reported. BaTiO₃ and Dy₀.₅Li₀.₅TiO₃ were prepared by solid state reaction between respective oxides at 1300°C for 12 hr and cooled to room temperature in air. Pure Dy₀.₅Li₀.₅TiO₃ crystallizes in the orthorhombic system with unit cell parameter a = 5.302 A, b = 5.589 A, c = 7.622 A. The pure compound has a tolerance factor of 0.746 so that the structure could be visualised as orthorhombic distortion of cubic perovskite structure. This observation is in agreement with that of Schröder et al., who placed a lower limit of 0.78 for the rare-earth mixed oxides and that of Keith and Roy, who placed a lower limit of 0.77 for perovskite structure of the A²⁺B⁴⁺O₆⁻ type. The unit cell parameters were determined at various compositions by x-ray powder diffraction technique on Philips x-ray diffractometer (PW 1051) using Cu-Kα radiation of wavelength (λ) = 1.5405 A filtered with Ni foil. The values were calculated accurately to ± 0.2%. For finding interplaner spacings, tables supplied by X-ray Department of General Electric Company, USA, were used. Table 1 shows the variation in unit cell parameters of the system.

It can be seen that the orthorhombic strain (b/a 1.054), present in pure phase disappears by the addition of 20 mole% of BaTiO₃, since the tolerance factor for the composition increases to 0.750. The c/a value goes on decreasing as Ba²⁺ concentration increases in contrast with the normal expectation of increase in tetragonality (c/a) with increase in size of the ion (Ba²⁺ = 1.35 Å, Dy³⁺ = 0.92, Li⁺ = 0.60 Å). It is also seen that r value increases with Ba²⁺ concentration so that the structure gradually changes to that of the perovskite lattice, where the tetragonality (c/a) is nearly 1.0 for pure BaTiO₃. This may be due to the polarization effect at the A site since it is known that the polarization may play an important role in determining the symmetry formed by a given perovskite structure. The measured density values gave Z value of 4 for Dy₀.₅Li₀.₅TiO₃ phase which reduces to 1 for and beyond 20 mole% BaTiO₃ incorporation into the lattice.

**Table 1**

<table>
<thead>
<tr>
<th>Composition</th>
<th>Symmetry</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>c/a</th>
<th>b/a</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dy₀.₅Li₀.₅TiO₃</td>
<td>O</td>
<td>5.302</td>
<td>5.589</td>
<td>7.622</td>
<td>1.437</td>
<td>1.054</td>
<td>0.746</td>
</tr>
<tr>
<td>Ba₂₀Dy₀.₅Li₀.₅TiO₃</td>
<td>T</td>
<td>3.686</td>
<td>3.686</td>
<td>4.461</td>
<td>1.210</td>
<td>1.000</td>
<td>0.750</td>
</tr>
<tr>
<td>Ba₄Dy₀.₅Li₀.₅TiO₃</td>
<td>T</td>
<td>3.867</td>
<td>3.867</td>
<td>4.610</td>
<td>1.192</td>
<td>1.000</td>
<td>0.821</td>
</tr>
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<td>Ba₈Dy₀.₅Li₀.₅TiO₃</td>
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<td>4.442</td>
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</tr>
<tr>
<td>Ba₁₂Dy₀.₅Li₀.₅TiO₃</td>
<td>T</td>
<td>3.921</td>
<td>3.921</td>
<td>4.090</td>
<td>1.043</td>
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<td>0.897</td>
</tr>
<tr>
<td>Ba₁₆Dy₀.₅Li₀.₅TiO₃</td>
<td>T</td>
<td>3.99</td>
<td>3.99</td>
<td>4.01</td>
<td>1.010</td>
<td>1.000</td>
<td>----</td>
</tr>
</tbody>
</table>

O = Orthorhombic; T = Tetragonal.
The author wishes to thank Dr. V. S. Chinholkar of Forensic Science Laboratory, Bombay for his useful suggestions.

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NATURE OF PALAEOCURRENTS AND ENVIRONMENTAL SIGNIFICANCE OF VINDHYANS (KAIMUR QUARTZITE) AROUND CHITTAURGARH, RAJASTHAN

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To work out the process and direction of transport of sediments, orientation of the basin of deposition and palaeo-geographical history of the rock units, palaeocurrent analysis is the most important method. The present note is confined to the study of palaeocurrent systems and environmental significance which are determined from cross-stratification and ripple mark measurements respectively. These structures are well observed in the Kaimur Quartzite of Kaimur series at the Chittaurgarh Fort.

Compass diagrams have been found to be more useful than the conventional rose diagrams. The compass is divided into 12 sectors, each comprising an arc of 30°. The mean of the number of measurements per sector and the standard deviation of the number of measurements per sector are calculated (figure 1). The compass diagram has been prepared for 36 cross-bedding directions, measured in the Kaimur Quartzite. The compass diagram shows only one mode towards East. Thus it can be easily deduced that the direction of palaeocurrents was from west to east.

Only two structures, viz. ripple markings and cross-stratification were used as tools to study the Environmental significance. Cross-stratification may originate from (i) migration of ripples (ii) scour and channel fill features (iii) deposition on point bars of small meandering channels and (iv) inclined surface of beaches and bars. Ripple marks are symmetrical oscillation ripple marks; 31 measurements were carried out. These reveal that the ripples are symmetrical, their amplitude ranging from 0.27 to 0.5 cm and their wavelength from 2.1 to 2.45 cm thus giving a ripple index from 5 to 7.5; trends of the ripples are parallel to sub-parallel and occasionally joined.

Ripple marks are produced due to action of air or water. An index 5 to 7.5 suggests that the ripples have been produced under aqueous conditions, symmetrical ripple marks are developed when shallow sandy bottoms of standing water bodies are agitated by to-and-fro motion of waves. The ripple marks indicate deposition under aqueous conditions. Symmetrical ripple marks suggest that water laid down in a quiet water environment.

<table>
<thead>
<tr>
<th>Sedimentary structure</th>
<th>Probable environmental significance</th>
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</thead>
<tbody>
<tr>
<td>Planar cross-stratification</td>
<td>Aqueous, Fluvial</td>
</tr>
<tr>
<td>Symmetrical ripple marks</td>
<td>Aqueous, quiet water beach</td>
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</table>

The authors thank Professor U. Aswathanarayana for facilities and to Dr B. Das for valuable guidance.

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