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## **An Investigation of the Thermal Individuality of Complex Polymers by the Use of Micro Filled Erbium Oxide**

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### **ABSTRACT**

*This article describes a study that focuses on the individuality of compound polymeric constituents. The present study includes a material description, experimental results, and test results for the physical, mechanical, and microstructure of "Epoxy" and "polypropylene" composites containing erbium oxide particles of micron-sized dimensions. Based on these findings, a mathematical connection has been developed to approximate the effective thermal conduction of polymer compounds by uniform distribution of micro-sized particle fillers. Erbium oxide-filled polymer has been correlated using numerical analysis and experiments. Erbium content is influenced by the thermal properties of glass transition temperature ( $T_g$ ) and coefficient of thermal expansion (CTE) of "EPOXY" and "POLYPROPYLENE" compounds, and this report details the experiment.*

**Keywords:** Epoxy; Polypropylene; Erbium Oxide Particles; Particle Fillers; Glass Transition Temperature ( $T_g$ ); Coefficient of Thermal Expansion.

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### **1.0 Introduction**

It is generally agreed upon that micro-electronic packaging plays an important part in the explosive expansion of electronic and electrical advancements. When a microelectronic circuit is working, it generates a lot of heat. Rather than simply possessing the usual physical qualities of physio-mechanical bundling, the materials must have high warm conductivity in order to avoid an overheat incident. In order to reduce the signal propagation time, these bundling materials must have low relative permittivity and low dielectric misfortune [1-4].

There is a requirement to introduce the judgments made during Scrutinize in the current chapter. As a result of the available examination, this written works study is intended to provide foundation facts on the concerns discovered and thus frame the destinations [5-7]. Different sections of particle filled polymer compounds are included in this treatise to provide an exceptional reference to their warm properties [8-9]. These studies include accessible reports on thermal conduction and its models of polymer matrix compounds loaded with particulates, as well as reports on the  $T_g$  and CTE of polymer compounds, and ultimately on erbium di-oxide. With this amount of time and effort, the goals that we have set for ourselves are as follows: The forecast for the thermal conductivity of polymer composites with micro-sized particle fillers has been updated ( $k_{eff}$ ). The heated conductivities of epoxy and polypropylene microparticles are measured. Also measured are the

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conductivities of polypropylene microparticles. The FEM and the proposed hypothetical model are both capable of accepting the calculated quality ( $k_{eff}$ ) of compounds based on the study of the  $k_{eff}$  values [10-14].

## 2.0 Aims of the Current Work

Following are the objectives for this level of effort: Now, it is easy to predict that polymer composites containing minute particles will exhibit strong heat conductivity ( $k_{eff}$ ). The heated conductivities of microparticles of erbium di-oxide synthesized from epoxy and polypropylene are measured. After considering hypothetical values for compounds' computed quality, the recommended hypothetical model and FEM are adopted ( $k_{eff}$ ).

Figure 1: LY556 Epoxy Resin



Figure 2: Filler Material



### 2.1 Matrix material-1 (epoxy)

Epoxy resins are frequently used for a variety of advanced mixes due to their exceptional bond to a fully mixed bag of fibres, their predominant mechanical and electrical properties, and their ease of use at higher temperatures, all of which are made possible by the readily available thermosetting polymers.

### 2.2 Grid material-2 (polypropylene)

It is possible that the thermoplastic grid used for these display exams includes polypropylene, also known as propane. In order to make polypropylene, the atomic formula for it will be  $(C_3H_6)_n$ . Wearing polypropylene is a popular choice because of its excellent mechanical presentation and aesthetics as well as its low cost, resistance to chemicals, and ability to be reused.

### 2.3 Filler material: (erbium oxide)

Thermally conductive polymer composites are trained with the help of micro-sized Erbium oxide filler.

## 3.0 Experimental results

Normal molecular size Erbium oxide powders of about 90–100 nm would be supplied by QualiChem Ltd. Towards The oxide structure of titanium is what we're talking about here. What's

more, it occurs in a similar manner to rutile, anatase, or brookite. Limonite mineral may be the primary source of it. As far as we can tell, this may be the most widespread expression of erbium oxide-bearing metal ever seen. The erbium oxide metal structure rutilus will be the next readily available structure to be found. Metastable brookite and anatases transition to Rutilus when the temperature rises. Filler may use erbium oxide because of its ability to conduct heat directly. Erbium oxide, which is a filler material, will be shown from a visual standpoint in the following paragraphs: Fig. 3 also includes Table 1, which lists some of its most important characteristics

### **3.1 Thermodynamic efficiency (Keff)**

Thermal conductivities of epoxy compounds containing Erbium di-oxide fillers are conceptually and provisionally assessed. An evaluation and explanation of the results obtained from experimenting with different filler techniques will be shown.

### **3.2 Thermal conductivity**

In order to administrate that dimensional strength, materials used in these provisions need to have low CTE and moderate temperature fluctuations throughout operation.

### **3.3 Apparatus and electronic device for the thermal expansion coefficient**

The reaction of a new compound item to various physical, mechanical, and heated conditions is routinely used to decide on the fabric of acceptable arrangement for a random application, and this becomes essential for the display of any new compound item. The current effort obtained a substantial quantity of data on the properties of epoxy-Erbium oxide and polypropylene-Erbium oxide combinations by making them at the research centre and testing them under confined laboratory circumstances. To modify its physical, mechanical, and thermal properties, micro measured Erbium di-oxide particles are added to polymers. Their proximity changes the heat conduction of Erbium di-oxide microfillers. When combined with epoxy and polypropylene, Erbium oxide's conductivity improves grid performance. When the permeability limit is passed, warm extensions grow inside the lattice body, boosting conductivity. Since fixing the filler, the compound's warm conductivity has unexpectedly risen. Erbium oxide affects the glass change temperature and warm development of mixes.

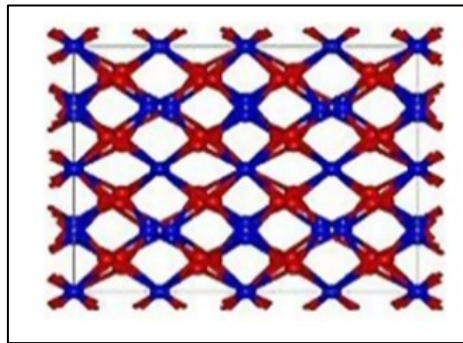
**Fig. 3: Erbium Oxide Powders**



**Table 1: Composition of Material**

Composition	Volume %	Ero2
PP + 0	Volume %	Ero2
PP + 2.5	Volume %	Ero2
PP + 5.0	Volume %	Ero2
PP + 7.5	Volume %	Ero2

**Fig 4: Structural Foam**



**Figure 5: Testing Equipment Includes a Compression Molding Machine, Scanning Electron Microscope, Leitz Micro Hardness Tester and Instron 1195 Universal Testing Machine**



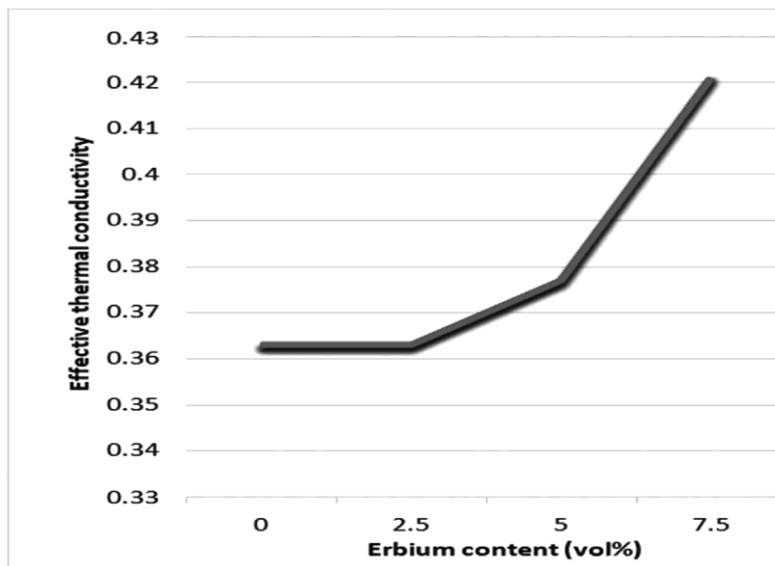
**Table 2: Effective Thermal Conductivity**

S. No	Effective Thermal Conductivity (W-mk)	Filter Content
1	0.365	0
2	0.367	2.5
3	0.375	5.0
4	0.425	7.5

**Table 3: Glass Transition Temperature (Tg)**

S. No	Filler content (vol%)	Effective thermal conductivity
1	0	0.11
2	2.5	0.32
3	5.0	0.14
4	7.5	0.16

**Figure 6: Temperature Dependence of Effective Thermal Conductivity of Glass with Erbium Oxide Content**



**Figure 7: Variation Glass Transition.**

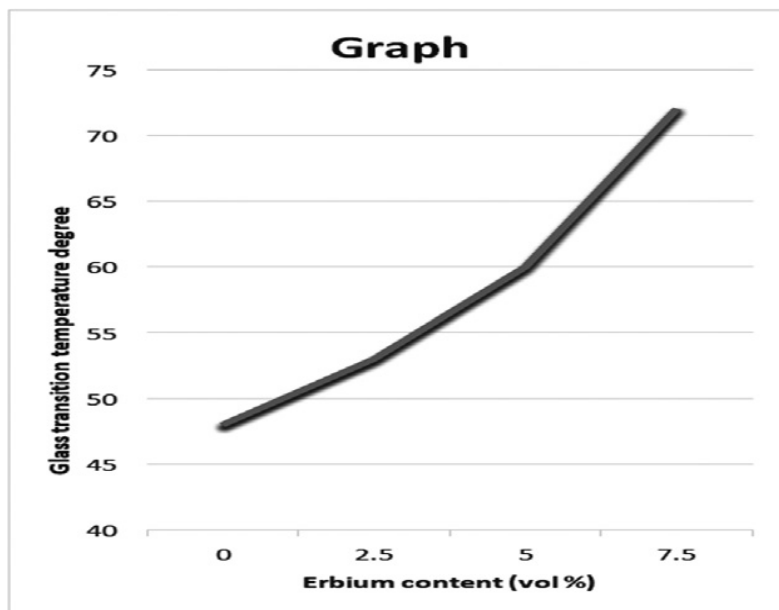


Figure 8: Expansion of the Thermal System

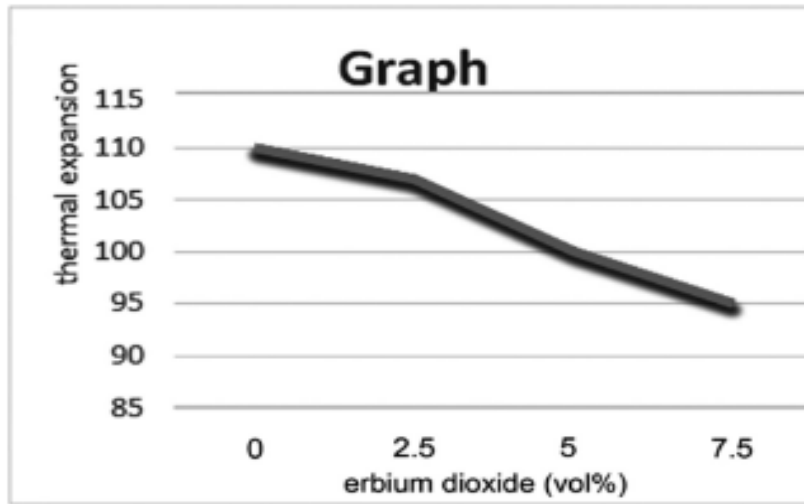
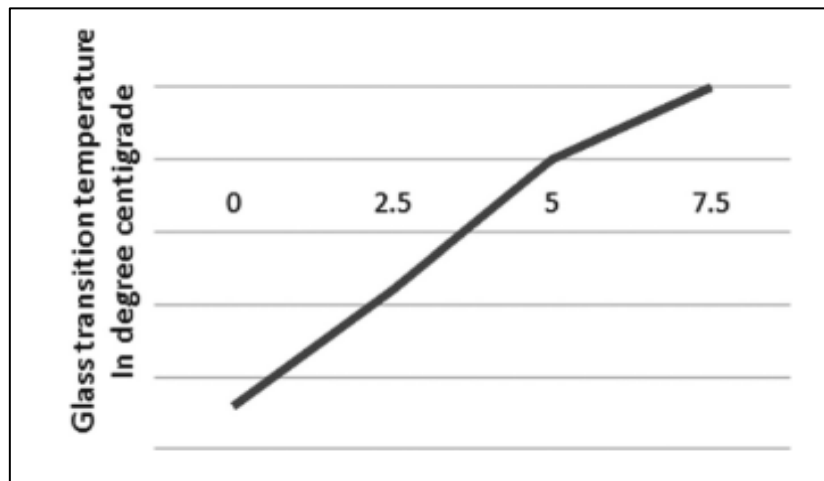


Figure 9: Glass Transition Temperature Variation with Erbium Oxide



#### 4.0 Conclusions

As a result of this research on epoxy and polypropylene blends loaded with tiny particles of erbium oxide, which included both explanatory material and experimental testing, the following specific results have been drawn:

When utilising the hand layup method, it is able to successfully construct particle filled epoxy-Erbium oxide mixtures. When using the pressure forming course, it is also possible to successfully produce polypropylene-Erbium oxide mixtures.

The malleable and compressive properties of the mixtures are affected when particles of erbium oxide are used as a filler. It can be shown that the elasticity of both mixes is barely affected by the expansion of erbium oxide particles, and that this change in elasticity is a result of the filler content. The amount of filler in these mixes has a significant impact on the microhardness, thickness, and porosity of the mixtures as well.

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