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Application of Fuzzy Min-Max Composition in Polymer Composite

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Abstract - This paper presents a new technique which uses the principle of Fuzzy Min-Max composition for the polymer composites and also it gives more information about electrically resistant polymer.

Keywords - Fuzzy relations, Composition of Fuzzy relation, Application of Fuzzy relations.

I. INTRODUCTION

A.Zadeh introduced the concept of fuzzy set theory in 1965,Fuzzy set theory is an extension of classical set theory. In every day content most of the problems involve imprecise concept. To handle the imprecise concept. Fuzzy relations are significant concepts in Fuzzy Theory and have been widely used in many fields such as fuzzy clustering, fuzzy control and uncertainly reasoning. They also play an important role in fuzzy diagnosis and fuzzy modeling. Fuzzy relations are used in practice, how to estimate and compare them in a uncertainly measurements of fuzzy relations have been done by some researches. Similarity measurement of of uncertainly was introduced by Yeager who also discussed its application.

II. PRELIMINARIES

A. Definition

Let $X,Y \subseteq R$ be universal sets then; $R=\{(x,y),(\mu_R(x,y)) \mid (x,y) \in XxY\}$ is called a fuzzy relation in $XxY \subseteq R$ or X and Y are two universal sets, the fuzzy relation R(x,y) is given as $R(x,y)=\{ [\mu_R(x,y)/(x,y)] \mid (x,y) \in XxY\}$. Fuzzy relations are often presented in the form of two dimensional tables, Anmxn matrix represents a contended way of entering the fuzzy relation R.

B. Definition

Let $R_1(x,y),\{(x,y) \in XxY\}$ and $R_2(y,z),\{(y,z) \in YxZ\}$ be two fuzzy relations.The Min-Max composition R_1 Min-Max R_2 is then the fuzzy set $R_1{}^{o} R_2 = \{[(x,z), \min\{\max\{\mu_{R_1}(x,y), \mu_{R_2}(y,z)\}\}] \mid x \in X, y \in Y, z \in Z\}$ $\mu_{R_1 \circ R_2}$ isagain the membership function of a fuzzy relation on fuzzy sets. A more general definition of composition is the "min-max" composition.

C. Definition

Let $R_1(x,y),\{(x,y) \in XxY\}$ and $R_2(y,z),\{(y,z) \in YxZ\}$ be two fuzzy relations.The min-product composition $R_1{}^{o}R_2$ is then the fuzzy set is $R_1{}^{o}R_2 = \{[(x,z), \min\{\mu_{R_1}(x,y), \mu_{R_2}(y,z)\}] \mid x \in X, y \in Y, z \in Z\}$

D. Definition

Let $R_1(x,y),(x,y) \in XxY$ and $R_2(y,z),(y,z) \in YxZ$ be two fuzzy relations. The min-av composition $R_1{}^{o}R_2$ is then the fuzzy set is $R_{1_{av}}$ $R_1{}^{o}R_2(x,z)=[(x,z),(1/2) \min\{\mu_{R_1}(x,y) + \mu_{R_2}(y,z)\}] \mid \mid x \in X, y \in Y, z \in Z\}$uncertainly was introduced by Yeager who also discussed its application.

III. OVERVIEW OF POLYMER COMPOSITES

Materials are made from two or more constituent material with significantly difference physical or chemical property. Dielectric constant is an electrical insulator that can be polarized by an applied electric field when dielectric is placed in a electric field electric charges do not flow through the material as they do in a conductor. Polymer composites are considered to be an important and essential high performer material.Cyanate ester (CE;(4-cyanatophenyl)propane), a class of thermosetting phenolic resins, possesses a number of attractive properties such as high glass transition temperature and good mechanical properties, including excellent resistant to moisture absorption. Polymerization of CE occurs via thermally activated addition reaction with formation of polycyanurates without producing any volatile compounds.

The excellent thermo mechanical properties of CEs make them useful for microelectronic applications. The properties of CE resins are superior to polyester, epoxy, polyimide, and bismaleimide resins. The flame- retardant behavior of ces can be greatly enhanced by the incorporation of phosphorous-based precursors.An incorporation of 5, 10,15 and 20% P in to CE matrix system improves the values and thermal stability. The values of dielectric constant and dielectric loss are found to be decreased with increase in the concentration of CPA due to its insignificant polarizability. Data resulted from different studies indicate that these Cyanate ester hybrid materials can find application in the field of microelectronic applications for better performance than conventional CEs.

A. Dielectric constant (DC)

The dielectric constant is the ratio of the permittivity of a substance to the permittivity of free space. It is an expression of the extent to which a material concentrates electric flux, and is the electrical equivalent of relative magnetic permeability.

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B. Dielectric loss (DL)

The loss of energy in an electrically insulating material. A material with low dielectric loss dissipates a relatively low amount of heat when subjected to electrical current.

C. Differential scanning calorimetric (DSC)

Differential scanning calorimetry can be used to measure a number of characteristic properties of a sample. Using this technique it is possible to observe fusion and crystallization events as well as glass transition temperatures T_g. DSC can also be used to study oxidation, as well as other chemical reactions.
Glass transitions may occur as the temperature of an amorphous solid is increased. These transitions appear as a step in the baseline of the recorded DSC signal. This is due to the sample undergoing a change in heat capacity; no formal phase change occurs. n general, a higher Tg allows for greater thermal stability and helps to prevent defects during the curing of a part.

D. Thermogravimetricc analysis (TGA)

TGA can be used to evaluate the thermal stability of a material. In a desired temperature range, if a species is thermally stable, there will be no observed mass change. Negligible mass loss corresponds to little or no slope in the TGA trace. TGA also gives the upper use temperature of a material. Beyond this temperature the material will begin to degrade. TGA has a wide variety of applications, including analysis of ceramics and thermally stable polymers.

IV. CASE STUDY

In this model we can predict using min-max composition, min product composition and min-av composition.

X= Compounds ={Cyanate ester (neat)[CE], phosphazene[P]}
Y= Various % of Phosphazene

Table -1

X	Dielectric constant	Dielectric loss	DSC	TGA
CE	0.8	0.4	0.8	0.94
P	0.6	0.2	0.75	0.9

Where, CE=cyanate ester, P=Phosphazene

Table 2

Y	P(5%)	P(10%)	P(15%)	P(20%)
DC	0.8	0.64	0.61	0.84
DL	0.8	0.4	0.2	0.6
DSC	0.73	0.74	0.75	0.9
TGA	0.73	0.86	0.99	0.81

Where, Dielectric constant=DC, Dielectric loss=DL, Differential Scanning caolorimetric=DSC
Thermogravimetriv analysis=TGA

A. Algorithm

a) Min-Max Composition
XoY = Relationship between cyanate ester to various % of phosphazene composites
= Min {max (0.8,0.8),max(0.4,0.8),max(0.8,0.73),max(0.94,0.73)}
= Min {0.8, 0.4, 0.8, 0.94}
= 0.4

Similarly we can calculate the other entries
The relational Matrix for min-max composition in fuzzy relational in thus

Table 3

$X \circ Y$	Dielectric constant	Dielectric loss	DSC	TGA
CE	0.4	0.4	0.4	0.6
P	0.6	0.4	0.2	0.6

b) Min product composition
X^oY = Relationship between cyanate ester to various % of phosphazene composites

= min {0.64, 0.32, 0.58, 0.68}
= 0.32

Similarly we can calculate the other entries
The relational matrix for min product composition in fuzzy relational in thus,

Table 4

$X \circ Y$	Dielectric constant	Dielectric loss	DSC	TGA
CE	0.32	0.16	0.08	0.24
P	0.16	0.08	0.04	0.12

c) Min-av composition
X^oY= Relationship between cyanate ester to various % of phosphazene composites

=1/2 min {1.6, 1.2, 1.5, 1.67}
=1/2(1.2)
=0.6

Similarly we can calculate the other entries
The relational Matrix for min-av composition in fuzzy relational in thus,

Table 5

$X \circ Y$	Dielectric constant	Dielectric loss	DSC	TGA
CE	0.6	0.7	0.3	0.5
P	0.5	0.4	0.2	0.4

V. CONCLUSION

The hyper cross linked P/CE hybrid composites were prepared and there in corporation of 5, 10, 15 and 20% P in to CE matrix

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system improves the values of Tg and thermal stability with enhanced char yield and The values of dielectric constant and dielectric loss are found to be decreased with increase in the concentration of P due to its insignificant polarizability. Data resulted from different studies indicate that these P/CE hybrid materials can find application in the field of microelectronic applications for better performance than conventional CEs.

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