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Study of Material Transformation

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Abstract

As the applications of Electronics are increasing, the demand for more versatile materials is also increasing. Here this study is presented on the transformation of different oxide materials between semi-conducting, conducting and dielectric states using mass law of mixing. Various properties of oxide materials such as, resistivity, coercivity, dielectric constant, etc. were studied and compared using fuzzy logic. Comparison of the densities of different oxides with that of earth (5.53 gm/cc) is done. This is verified large number of components of oxides can be mixed, heated and prepared to make a desired material. The reliability attributes of oxides and elements of materials using resistivity have been discussed.

Keywords: The 4 keywords that have been used in this paper are resistivity, coercivity, transition temperature and dielectric constant.

Introduction

This document is devoted to study of the resistivity of oxides materials here, several oxides are brought to the study using the mass law of mixing [7,8,9]. Experimental evidence is explained in this chapter taking density(Dg/cm^3), resistivity (ρ Ω-m), and dielectric constant, (ε_r) The volumetric contents are verified experimentally.

Here (D1,ρ1,єr1,v1), (D2,ρ2,єr2,v2) and (D3,ρ3,єr3,v3) are the density, resistivity, dielectric constant and volumetric content, respectively of the three materials to be mixed. The resistivity (ρ), density (D) and dielectric constant(ε_r) follow the mass law of mixing and therefore they are physical parameters and constant for materials [1,2,3].

The densities of the materials studied are compared with that of Earth (5.53 gm/cc).Properties of materials having densities greater then and less than that of Earth are discussed. All other non-metallic solids (SiC, TiC, Al2O3, MgO, Quartz fiber, etc.) have densities lower than that of Earth.

Coercivity and transition temperature of material are also discussed. The coercivity of electrical alloys of elements is important parameter to design the computer memory elements to make the permanent poles of small motors and instruments . The coercivity is a ratio of H_c and H_{max} .

These parameters are well known in the Hysteresis loop test of materials. The temperature also falls down when resistivity is increased. One can study the alloys of elements and then the oxides of the same elements and a difference and utility will be pointed out. Retentivity and tensile strength with the resistivity of the alloys will also be explained. These laws are electromechanical laws, Where electrical parameter can change the mechanical parameters. We can increase the resistivity of alloying the materials of oxides and elements.

The resistivity will depend on temperature (T), Density (D) and coercive force (H_c). The retentive force will also depend on the resistivity.There is no dielectric component in the mixture. In this chapter relation among the ρ, D and ε_v is explained. One can control the resistivity using several parameters [10].

Universal law of mixing for several parameter has been explained. Several oxides like ZnO, NiO, CuO, Cu_2O_3, Fe_2O_3,Fe_3O_4,HgO and Al_2O_3 are brought to the study for resistivity ρ, Density D, dielectric constants ε_r , magnetic permeability μ_r , MP, BP, Tc, T,V,SH and n the refractive index of light. The parameter may control the resistivity of the oxides. One has to investigate large properties of a sample to mix with large constituents components. A solution has been prepared here [9,10].

The steels are peculiar materials that do not obey mass law of mixing, one can investigate. The dielectric, semiconductor and conductor follow mass law and log law of mixtures and alloys. The mixtures of semi conductors also do not obey these two laws.

Electrical steels are good alloys and they follow mass law of mixing as well the logarithmic law of alloying.

Reliability attributes of oxides and elements of materials using resistivity and many parameters [6] have been discussed. The inverse of the matrix has been found using desired equations, digital computers and Fuzzy logic transformation .

Material Transformation

The oxide materials are the composite materials consist of conductors. Semi conductors and dielectrics. This type of study is very important because the ZnO, MgO, SiO2, CuO, Cu2O3, etc is semi conductors as well as the dielectric. There should be a model to study a mixture of conductors, Semi-conductors, and dielectrics.

Assume that D_1, D_2 and D_3 are the densities of conductors, Semiconductors, and dielectrics. Similarly P_1, P_2 and P_3 for the some called resistivities, and $\varepsilon_r, \varepsilon_{r2}$ and ε_{r3} are dielectric constants of three materials. The measured parameters of the mixture are D, P and ε_r, v_1, v_2 and v_3 are the volumetric contents of the conductor, semi conductor and dielectric components. One can use the mass law of mixing as follows :

$$D = D_1 V_1 + D_2 V_2 + D_2 V_3$$

$$\rho = \rho_1 V_1 + \rho_2 V_2 + \rho_3 V_3$$

$$\varepsilon_r = \varepsilon_{r1} V_1 + \varepsilon_{r2} V_2 + \varepsilon_{r3} V_3 \quad (1)$$

In matrix form, it can be written as follows :

$$\begin{bmatrix} D \\ \rho \\ \varepsilon_r \end{bmatrix} = \begin{bmatrix} D_1 & D_2 & D_3 \\ \rho_1 & \rho_2 & \rho_3 \\ \varepsilon_r, & \varepsilon_{r2} & \varepsilon_{r3} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} \quad (2)$$

$$\begin{bmatrix} 0.2 \\ 10^6 \\ 50 \end{bmatrix} = \begin{bmatrix} 10 & 20 & 1 \\ 10^{-8} & 10^3 & 10^{12} \\ 1 & 15 & 10 \end{bmatrix} \begin{bmatrix} 0.2 \\ 10^6 \\ 50 \end{bmatrix} \quad (3)$$

Or,

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 10 & 20 & 1 \\ 10^{-8} & 10^3 & 10^{12} \\ 1 & 15 & 10 \end{bmatrix}^{-1} = \begin{bmatrix} 0.2 \\ 10^6 \\ 50 \end{bmatrix} \quad (4)$$

The inverse of the matrix is found as follows :

$$\begin{bmatrix} 10, & 20 & 1 \\ 10^{-8} & 10^3 & 10^{12} \\ 1 & 15 & 10 \end{bmatrix}^{-1} = \begin{bmatrix} .115 & 0 & .1538 \\ .0077 & 0 & .077 \\ 769.23\times10^{-15} & 100\times10^{-15} & 7691^{-10} \end{bmatrix} \quad (5)$$

$$= \begin{bmatrix} 0.115 & 0 & .1538 \\ .0077 & 0 & .077 \\ 0 & 0 & 0 \end{bmatrix} \quad (6)$$

$$\begin{bmatrix} V1 \\ V2 \\ V3 \end{bmatrix} = \begin{bmatrix} .115 & 0 & .1538 \\ .0011 & 0 & .077 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0.2 \\ 10^6 \\ 50 \end{bmatrix} \quad (7)$$

$$\begin{bmatrix} V_2 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 7.713 \\ 3.85154 \\ 3.84731\times10^{-14} \end{bmatrix} = \begin{bmatrix} 8.0 \\ 4.0 \\ 0.0 \end{bmatrix} \quad (8)$$

V_1 = Conductor material component = 8.00

V_2 = Semi conductor material component = 4.00

$$V_3 = o \quad (9)$$

There is no dielectric component in the mixture. The measurement are very approximate. The density is 0.2 g/cm^3 due to bulging of oxides and the dielectric constant is 50.

Resistivity, Density and Dielectric Constant of Oxides Materials

The resistivity is related to the density and dielectric constant of materials. The resistivity (ρ), density (D) and dielectric constant(ε_r) follow the mass law of mixing and therefore they are physical parameters and constant for materials. In the above example of a mixture of conductor, semi conductor and dielectric the conductor material is 66.66% while semi conductor 33.33% and $V_3 = 0$. There are large number of materials whose density is less than the earth. The earth density in average is 5.53

g/cm^3. The study of these oxides and materials whose density is greater than and less than 5.53 g/cm^3 is done.

Aluminum = 2.71
Aluminum Strongly = 2.8
Magnesium =1.74 (10)
Sodium =0.97
Titanium =4.54

All other non-metallic solids have density lower than the earth density 5.53 g/cm^3. The properties of silicon carbide SiC, D=3.17 g/cm^3, titanium carbide, D=4.5 has been studied. The density of titanium is also 4.54. The quart2 fiber is also important whose D= 2.6 gm/cc., Magnesium oxide, D=3.6 gm/cc., Aluminum ceramic Al2O3 with D=3.8 gm/cc while density of aluminum is 2.71 g/cm^3. The density of magnesium is 1.74 and its oxide has a density of a oxides is always less than the density of the elements.

Earth, Air and Water

The effects of earth, air and water on oxides is essential for their stability and reliability as semiconductor and dielectric. We mix their parameters with oxides to determine as well as reliability attributers.

Earth

$$\varepsilon_r = 15,\ D = 5.517\ g/cm^3,\ \mu r = .9999\ \ \rho = 100\ \Omega - m. \tag{11}$$

Air

$$\varepsilon_r = 1.0006, \mu_r = .9999,\ \rho = 100\ \Omega - m\ \ \ D = .001293\ g/cm^3$$

Water

$$\varepsilon_r = 81,\ \ \mu_r = .9999,\ \ \ \ \rho = 100\ \Omega - m\ \ D = 1g/cm^3 \tag{12}$$

Mixture of Cermets, Ceramics and Ferrites Derived from Oxides

An alloy or a mixture of cermets ceramic and Ferrite is taken with unknown volumetric contents, V_1, V_2 and V_3. The resistivity (ρ), permittivity (ε_r) and density (D) are measured

$$\varepsilon_r = 6,\ D = 0.76,\ \rho = 14 \times 10^6 \tag{13}$$

The mass law inverse will field:

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 77.6\% \\ 67\% \\ 71.7\% \end{bmatrix} = \begin{bmatrix} .776 \\ -.67 \\ .717 \end{bmatrix} \tag{14}$$

$$V_1 + V_2 + V_3 = 216$$

Then,

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} .3587 \\ -.3897 \\ .3314 \end{bmatrix} \quad (16)$$

Here it is obtained

$$V_1 + V_2 + V_3 = 1.0798$$

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 7.713 \\ -\ 3.85154 \\ 3.8473 \times 10^{-10} \end{bmatrix} \quad (17)$$

The mean of the random variable has been obtained using distribution function of mass law.

$$\begin{bmatrix} D \\ \rho \\ \varepsilon_r \end{bmatrix} = \begin{bmatrix} 26 \\ 10^6 \\ 50 \end{bmatrix} = \begin{bmatrix} 10 & 20 & 1 \\ 10^{-8} & 10^3 & 10^{12} \\ 1 & 15 & 10 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} \quad (18)$$

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} .66 \\ .33 \\ 0 \end{bmatrix} \quad (19)$$

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} .3587 \\ .3897 \\ .3314 \end{bmatrix} \quad (20)$$

Fuzzy logic membership functions will be assigned to the $V1, V_2$ and V_3

Cerment = .3587 = FM: Fuzzy member
Ceramic = .3897 = FM: Fuzzy member (21)
Ferrite = .3314 = FM: Fuzzy member

Large Number of Components of Oxides can be Mixed, Heated and Prepared to Make a Desired Material

Here large properties of a sample to mix with large constituents components are investigated. A solution is prepared as follows:-

Density = D
Thermal conductivity = TC
Resistivity =ρ
Tensile strength= T
Permittivity = εr
Viscosity = V (22)
Permeability = μr
Specific heat = SH
Melting point = MP
Refractive index =n
Boiling point = BP

$$\begin{bmatrix} D \\ \rho \\ \varepsilon r \\ \varpi r \\ MP \\ BP \\ Tc \\ T \\ V \\ SH \\ n \end{bmatrix} = \begin{bmatrix} D_1 \ldots\ldots D_{11} \\ \rho_1 \ldots\ldots \rho_{11} \\ \varepsilon_{r\,1} \ldots\ldots \varepsilon_{r\,11} \\ \mu_{r\,1} \ldots\ldots \mu_{r\,11} \\ MP_1 \ldots\ldots MP_{11} \\ BP_1 \ldots\ldots BP_{11} \\ Tc_1 \ldots\ldots Tc_{11} \\ T_1 \ldots\ldots T_{11} \\ V_1 \ldots\ldots V_{11} \\ SH_1 \ldots\ldots SH_{11} \\ n_1 \ldots\ldots n_{11} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \\ V_7 \\ V_8 \\ V_9 \\ V_{10} \\ V_{11} \end{bmatrix} \quad (23)$$

The inverse of the matrix using digital computers and using Fuzzy logic transformation is found out. Study Cu_2O_3, Fe_2O_3, Fe_3O_4, HgO and Al_2O_3 oxides and the reasons of reducing the density of the oxides is studied here.

Cu_2 O_3: The density of copper is 8.96 and that of oxide Cu_2O_3 is 6. There is a reduction in density.

$$8.96\text{-}6\text{=}2.96 \quad (24)$$

The resistivity of copper is $1.7 \times 10^{-8}\ \Omega - m$ and that of oxide is $90\ \Omega - m$. The dielectric constant is 14, it is a dielectric material. The change in resistivity is infinitely high.
The magnetic permeability $\mu_r = .999$ and it is diamagnetic materials.

Fe_2O_3: The density of Iron is 7.87 that of oxide is 5.24. The change in density will be:

$$7.87\text{-}5.24\text{=}2.63 \quad (25)$$

The electrical resistivity of Iron element material is $10 \times 70^8\ \Omega - m$ while that of Fe_2O_3 and $200\ \Omega - m$. The dielectric constant $\varepsilon_r = 7$ and $\mu_r = 1400$. This is a magnetic material. The melting point of the oxides is reduced to great extent.

Fe_30_4: The density of the oxide is 5.18 and that of Iron is 7.87 the reduction in density would be:

$$(7.87\text{-}5.18)\text{=}2.69 \quad (26)$$

The electrical resistivity of oxide is $300\ \Omega - m$. The magnetic permeability is $\mu_r = 1600$ and $\varepsilon_r = 6$. This is a ferromagnetic materials and good dielectrics will disturb the dielectric properties. The utility of Fe_3O_4 of Iron is disturbed.

The melting point is also reduced to 1810^{oc}. The refractive index of light is 2.42 and :

$$(\varepsilon_r)^2 = n^4 \quad (27)$$

$$n^2 = \varepsilon_r$$

$$5.8564 = 6(given)$$

This is an electronic materials and can be polarized by electronic polarization.

HgO: The density of mercury element material is $13.546\ g/cm^3$ **and that of the oxide is** $11.1\ g/cm^3$**. The reduction in density noted is**

$$13.546 - 11.1 = 2.446 \tag{28}$$

Melting point of mercury is 234$^{\circ c}$ and thermal conductivity $7.96\ W/mk$. The melting point of HgO is 800$^{\circ c}$ This is liquid material and its oxide MP is raised to 800^{o} from 234$^{\circ c}$ The resistivity of HgO is 800$^{\circ c}$ from 234$^{\circ c}$ the resistivity of HgO is $100\Omega - m$ equal to that of the earth materials. The refractive index of light is n=2.5 and $\varepsilon_r = 10$ with $\mu_r = 1$ This is the first oxide whose MP is increased while all other oxide's MP's are reduced considerably.

Al2O3:

The density of Al_2O_3 is 3.965 g/cm^3 while that of Al, is 2.7 g/cm^3 The density is increased, this is also an oxide that is out of way of all the oxides of the study. Melting point is 2290 and resistivity is $\rho = 100\ \Omega - m$, for Al_2O_3 and the Al, has a resistivity 2.65×10^{-8} which, is a good conductor. The permittivity $\varepsilon_r = 12$ and $\mu_r = 1$. The refractive index of light is $n = 1.78$.

This material is a good dielectric at $\varepsilon_r = 12, \mu_r = 1$and $\rho = 100\Omega - m$. We need dielectrics as non-magnetic material. The aluminum, Al is a paramagnetic material and its oxide is non-magnetic material.

SiO2:

The silicon Si has a density 2.3 g/cm^3 and resistivity $0.3\ \Omega - m$. The SiO_2 has a resistivity $\rho = 100$ and density 3.1 g/cm^3. The density is raised to 3.1 g/cm^3 from 2.3 g/cm^3. This is also a peculiar oxide like Al_2O_3 and MgO.

Study of Coercivity and Transition Temperature of Materials as a Function of Resistivity:

The coercivity of electrical alloys of elements is important parameter to design the computer memory elements to make the permanent poles of small motors and instruments. The coercivity and resistivity has a relation to make a compromise when resistivity increases the coercive for Hc is down. The coercivity is a ratio of H_c and H_{max}.

$$B_r / B_{max} = B_c = \text{Re}tentivity$$
$$H_C / H_{max} = coercivity \tag{29}$$

These parameters are well known in the Hysteresis loop test of materials. The temperature also falls down when resistivity is increased. The study of alloys of elements and then the oxides of the same elements and a difference and utility will be pointed out. Also the retentivity of the alloys is explained. This is a good practice to make a law to obtain low transition temperature for various steels of high tensile strength. Here tensile strength with the resistivity is studied. These laws are electromechanical laws. Where electrical parameter can change the mechanical parameters. We can increase the resistivity alloying the materials of oxides and elements,

The resistivity will depend on temperature (T), Density (D) and coercive force (H_c). The retentive force will also depend on the resistivity.

$$Coercivity = \frac{K_1}{\rho} = \frac{K_2}{D} = Hc$$

or

$$Hc = \frac{K_1}{\rho} + \frac{K_2}{D} \qquad (30)$$

$$\rho = \frac{K_3}{Hc} + \frac{K_4}{D} + \frac{K_5}{B_r} + \frac{K_6}{T_c}$$

The steels are peculiar materials that do not obey mass law of mixing the tone can investigate. The dielectric, semiconductor and conductor follow mass law and log law of mixtures and alloys. The mixture of semi conductors also do not obey these two laws.

The coercivity may be low, medium and high. We may express the coercivity law as follows :

$$H_c = \frac{K_1}{\rho^n} + \frac{K_2}{D^n} \qquad (31)$$

A tabular study of some alloys of Iron using resistivity (ρ), coercivity $Hc\, AT/m$ and Retentivity $B_r\ Wb/m^2$, in table 1. Is made:

Table 1

Materials	ρ $\Omega - m$	Coercivity AT/m	Tc critical temperature
50 cu, 50 Ni	3.007	160	980
49 Co 2V 49Fe	0.07	160	980
Fe	0.1	80	770
3.3 Si 96.7Fe	0.52	48	700
47 Ni 2 Cu 50 Fe	0.55	24	700
3.3 Si 1.7 Cr 95 Fe	0.6	16	700
50 Ni 50 Fe	0.61	4	700
78 Ni 32 Fe	0.65	4	500
78 Ni 22Fe	0.66	4	420
75Ni 2Cr 5Cu 8Fe	0.68	1.6	410
72 Ni 14Cu 3Mo 11Fe	0.68	1.6	290
79Ni 5Mo 16 Fe	0.8	3.2	400
9Si 5Al 86Fe	0.8	4.0	500

These materials in table 1 have greater reliability as compared to their oxides. Electrical steels are good alloys and they follow mass law of mixing as well the logarithmic law of alloying. The coercivity and Rctentivity change with the resistivity of alloys. The average reliability is 0.886.

Table 2

Electrical steels	ρ Ω-m	Coercivity AT/m	Retentivity wb/m^2
.6w+7c+.3 Mn+.93 Fe	0.1232	5200	1.0
.9Cr .6c .4 Mn .98Fe	0.1293	400	1.0
3.5cr .4Mn 95.1 Fe	0.1342	5200	0.9
36 Co 7w 3.5 Cr .9c 53.6 Fe	0.1923	16400	0.9
12 Co 7M_o 71Fe	0.0829	20000	1.0
.25 Ni 12 Al 63 Fe	0.0729	40000	0.7
15 Co 28c 57Fe	0.1839	7200	0.2

Electrical steels	ρ Ω-m	Coercivity AT/m	Retentivity wb/m^2
16 Co 9Cr Ic .3Mn 73.7Fe	0.1692	7200	0.2
12 Co 17Ni 10Al 6cm 55Fe	0.1321	44800	0.75
20Ni 60 Cu 20Fe	0.1629	36000	0.53
35Co 18Ni 6Al 8Ti 33Fe	0.1223	7200	0.57
77pt 223 Co	0.09123	21200	0.45
52 Co 11V 37Fe	0.1321	16000	1.15
24 Co 14ni 841 3Cu 51Fe	0.1221	7200	1.02

The critical temperature is well known by the scholars in Electrical Engineering but we need to explain it as the temperature on which the μ_r maximum is noted and after wards the μ_r goes on decreasing. These materials are called Ferromagnetic materials using the Fuzzy logic transformation the reliability of the alloys in table 2 is 0.8966. There is union between ρ, Hc, B_r of the materials. the T_c also form an union with ρ, H_c, B_r, T_c.

Resistivity (ρ) ***density thermal conductivity tensile strength and temperature coefficient of resistance*** α_R ***:***

*T*he data of ρ, D, Tc, T and α_R for various materials made from elements and then oxides will be collected and explained. These are our references. Table 3 stands for such results:

Table 3

Material	D g/cm^3	$\rho \times 10^{-8}\Omega - m$	Tc W/mk	T Mpa	α_R
Cu	8.93	1.7	385	150	0.039
Zn	7.14	5.9	111	150	0.004
Sn	7.3	11	65	30	0.005
Ni	8.9	59	59	300	0.006
Fe	7.8	10	80	300	0.0065
Pb	11.34	21	35	15	0.0043
Cr	7.2	25	36.9	300	0.006
Al	2.71	2.65	20.1	600	0.0016

The union and intersection theory can be used for D, ρ, Tc, T, α_R to find the reliability of the materials forming a group. These materials have a tendency to live together in the soil of the earth.

Large Number of Parameters of Copper and its Oxides

Copper has several parameters connected to the resistivity of the oxide of copper

D: Density : 8.93 g/cm^3

MP :Melting point 1356°k

L: Specific latent heat of evaporation $21 \times 10^4 \; J/kg$

CP: Specific heat capacity $385 \; Jkg/K$

α :Linear expansibility $1.7 \times 10^{-8}\Omega - m$

Tc: Thermal conductivity $385 w/mk$

ρ: Electrical Resistivity $17 \times 10^{-8} \; \Omega - m$

α_R: Temperature coefficient of resistance $= 39 \times 10^{-4}$

T: Tensile strength 150 Mpa

Y :Yield strength 75 Mpa

e: elongation 45%

E: Young modules 117 Gpa

σ :Poisson’s Ratio 0.35

Reliability of Materials: [10]

The reliability attributes of oxides and elements of materials using resistivity only and after wards many parameters have been discussed here. The parameter vector of the copper can be written as follows. The failures take place in the parameters of the materials. Copper is represented in mass law vector as follows:

$$[P]=\begin{bmatrix} \mathrm{T}c \\ \sigma \\ \mathrm{D} \\ \mathrm{M}P \\ \mathrm{S} \\ \mathrm{C}P \\ \alpha_t \\ \alpha_R \\ \mathrm{T} \\ \mathrm{Y} \\ \mathrm{e} \\ \mathrm{E} \end{bmatrix}=\begin{bmatrix} 385\,\mathrm{w/mk} \\ .588\times10^{-8} \\ 8930\,\mathrm{Kg/m^3} \\ 1356\,K \\ 21\times10^{4}\,\mathrm{J/kg} \\ 385\,\mathrm{J/kg}\,K \\ 17\times10^{-6}/K \\ 39\times10^{-4} \\ 150\,\mathrm{M}pa \\ 75\mathrm{M}pa \\ 45\% \\ 117\,\mathrm{G}pa \end{bmatrix}=[\mathrm{C_u}] \tag{31.b}$$

[10]

Every parameter form a life time and it reduces in a time period. The reliability would be:

$$R=e^{-\lambda t} \tag{32}$$

Where λ is the failure rate. All parameters will change if the resistivity changes. The fact will be discovered.

Reliability as a Material Property

The introduction of new materials for use in load bearing applications in a market place need the high standards of materials. The reliability is taken as granted by the designers of materials. there are two types of reliability static reliability and dynamic reliability.

Reliability in design of materials is called built in reliability and in working condition one call it dynamic reliability or Reliability of performance. The life of materials is very high but theoretically fails due to environmental conditions. The reliability of oxides is lower than their elements. Here the electrical reliability oxides will be studied as compared to the elemental materials and alloys. Reliability is calculated in the crisp space as well as in Fuzzy space. All the tables and standards are given in the crisp space. The research scholars admire the Fuzzy logic space for the reliability but they are no results for comparison. The crisp theory predicts only two states of working o or 1. Stop or working are the two conditions.

Some times oxides are very promising for long life as seen in the integrated circuit technology. The life of microprocessor is nearly 1000 years without any failure rate. The SiO_2 is the major component in the integrated circuit technology. We will discuss first the reliability in the crisp space

$$R(0,1) \tag{33}$$
$$R(0, .1, .2, .3, .4, .5, .6, .7, .8, .9, 1)$$

Thus the failure will push from 0 to 1 which is not the good assumption. The failure will push through ten steps it is true and practical in Fuzzy space. Reliability is given by:

$$R=e^{-\lambda t} \tag{34}$$

and $R+P=1$

where,

R : Reliability

P : Probability of failure

λ : Failure rate per hour or per year

If the life of a devise is 20 years then

$$\lambda = \frac{1}{20} = .05 \tag{35}$$

Then

$$e^{-.05t} = .9512 \tag{36}$$
$$t = 1\,year$$

In Fuzzy logic the reliability is a Fuzzy cardinality of the failure rate λ. The reliability is also on membership function of all the properties of a material represented in equation (31) a.

The conceptual model for failure of materials will be discussed here. The oxides have greater failure rate. Failure rate factors are as follows.

- Conceptual models of failure
- Stress strength
- Damage endurance [6]
- Challenge Response
- Tolerance Requirement

Mechanical failures in the materials are noted due to as follows:

- Elastic deformation
- Plastic deformation
- Buckling
- Brittles
- Ductile fractures
- Fatigue crack initiation
- Fatigue crack propagation
- Creep and creep rupture
- Tensile strength failures
- Large Elastic deformation
- Yield

Some other failures are noted in the oxides

- Broken wire, Discontinuity open circuit and short circuit.
- Thermal failures are results of heating a component beyond melting point or flash point, thermal expansion and contraction can cause mechanical stresses.
- Electrical failures include those due to Electrostatic discharge Dielectric break down, junction break down, not electron injection Surface and bulk trapping,

surface break down, Radiation failures may be caused by radioactive contaminants and secondary cosmic rays.

- Chemical failures are due to chemical environment which results in [6]
  - Corrosion
  - Oxidation
  - Ionic surface
  - Dendrite growth
  - Pollutants like SO_2, H_2S, and HCL

All these factors are used for the reliability of copper and copper oxides. The other oxides intimate lower reliability and they have poor tensile strength.

The composite materials for reliability problems can be formed. Given the impossibility of direct measurements of the desired reliability levels, we may try to obtain the data by mathematical analysis, starting from a much smaller number of experimental data.

Clearly the failure probability is proportional to the area under the overlap between those two distributions.

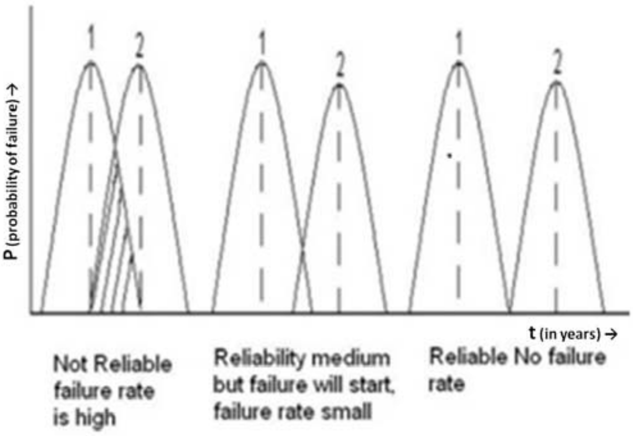

Figure 1: Failure Rate Small between two materials

Conclusion

After studying the various properties of oxide materials such as resistivity, coercivity, transition temperature, and dielectric constant, etc, we compare the densities of these materials with that of Earth with the help of fuzzy logic technique. We obtain such a mixture which would have low probability of failure and which would be reliable for use in various electronic applications, such as microprocessors, microcontrollers, manufacturing of small poles of motors, etc.

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