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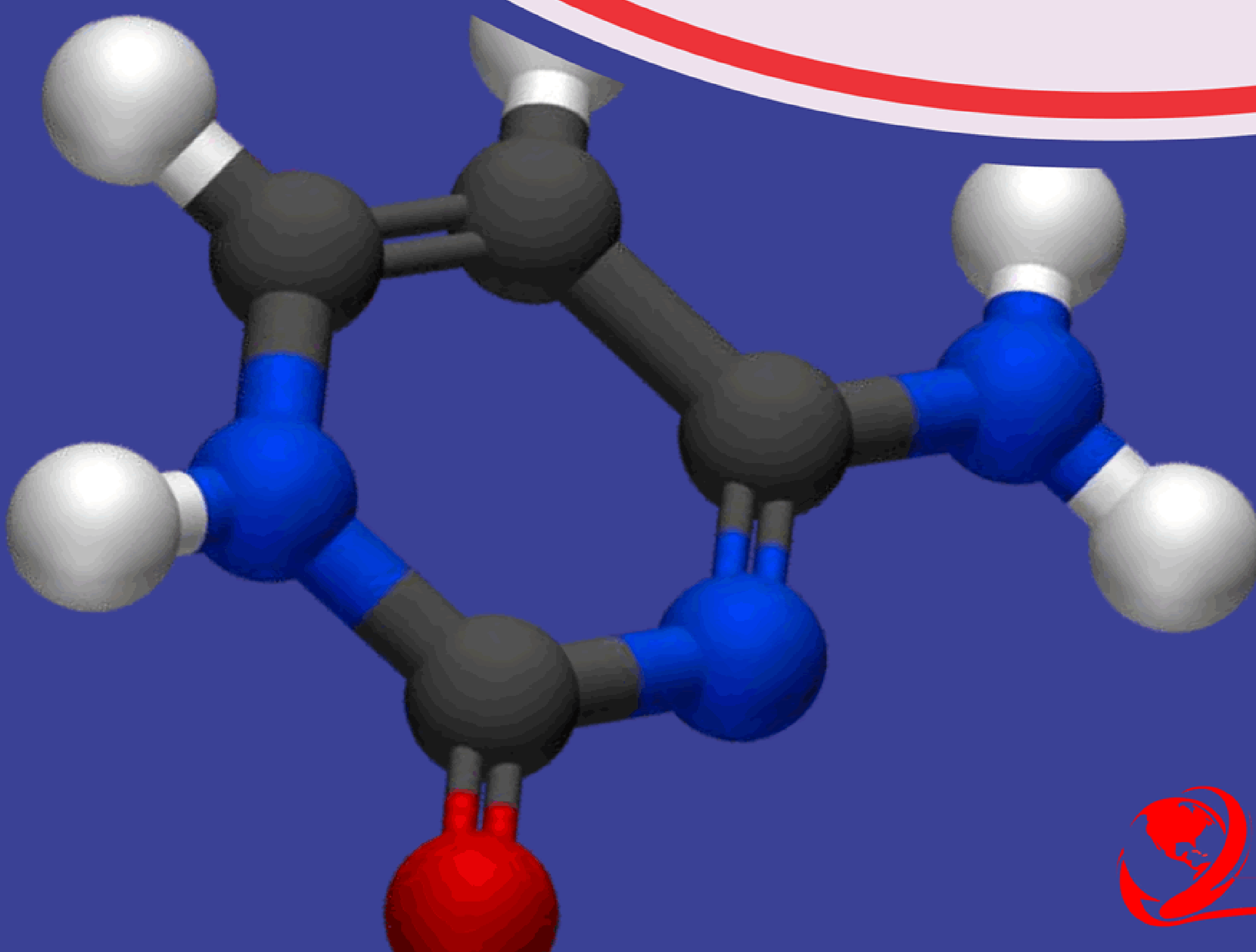

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ABSTRACT

The effective application usage of solid materials of cannot be granted if the fundamental properties of the material are unknown. Material characterization is one of ways science due apply to determine the fundamental properties of any material. The characterizations of materials in the various discipline of science are of different methods. This research work, processing and characterization of limestone nanoparticles as concern the field of material science was experimentally studied on three major categories: The micro structure using an optical microscope, in which the micro-structure image was obtained at its particulate of approximately 2.5nm. The absorbance obtained experimentally using an ultraviolet-visible spectrophotometer at wavelength raging from 190nm to 900nm. The transmittance, reflectance, refractive index was obtained mathematically, with the optical band gap obtained to be equal to 1.62eV. Finally the elemental composition was obtained using an Atomic Absorption Spectrometer (AAS), at which calcium was found to have the highest concentration among other metal present in the limestone nanoparticle.

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INTRODUCTION

Limestone is a kind of sedimentary rock that is very common all over the world, (Carr, 2017); it is composed mainly of skeletal fragments of marine organisms such as coral, forams and molluscs. Its major materials are the minerals calcite and aragonite, which are different crystal forms of calcium carbonate ($CaCO_3$). Limestone is also partially soluble, especially in acid and therefore forms many erosional landforms: which include limestone pavements, pot holes, cenotes, caves and gorges. Such erosion landscapes are known as karsts. Limestone is less resistant than most igneous rocks, but more resistant than most other sedimentary rocks. It is therefore usually associated with hills and down land, and occurs in regions with other sedimentary rocks, typically clays.Limestone has numerous uses: such as building material, an essential component of concrete (Portland cement), as aggregate for the base of roads, as white pigment or filler in products like toothpaste or paints, as a chemical feedstock for the production of lime, as a soil conditioner, and as a popular decorative addition to rock gardens. (Kranjc, 2006).

Nanoparticles are materials which have one or more of its dimension in the order of 100nmorless; useful in the manufacture of some products such as scratchproof eyeglasses, crack- resistant paints, anti-graffiti coatings for walls, transparent sunscreens, stain-repellent fabrics, self-cleaning windows and ceramic coatings for solar cells. At the nanoscale, the properties of particles may change in unpredictable ways. The nanoparticles of titanium oxide used in sunscreens, for example, have the same chemical composition as the larger white titanium oxide particles used in conventional products for decades, but nanoscale titanium oxide is transparent. (Kiss *et al*., 1999)

Material characterization, is a fundamental process in the field of materials science, without which no scientific understanding of engineering materials could be ascertained. (Leng, 2009). The study concerning Weathering of limestone building material by mixed sulfatesolutions: Characterization of stone microstructure, reaction products and decay forms. at which the, concentrated solutions promote massive subflorescences in both coarse and small pores, causing a disrupting effect that ultimately breakdown the stone.(Cardell *et al*., 2008)

The optimum usage of limestone (especially materials production) is found on its nano particulate nature and also applies for the best knowledge or description of any material basically at its atomic nature. As such this work processing and characterization of limestone nanoparticles becomes a necessity to promote and advance on the application of limestone.

MATERIALS AND METHOD

The materials used include the following: Limestone, Microscope, Water, Analytical Balance, Spatula, Beaker, Ultraviolent-visible Spectrophotometer and Atomic Absorption Spectroscopy.

Experimental Methods

The limestone was grinded and viewed on a microscope severally with a reasonable magnification until a nano-structure was obtained.

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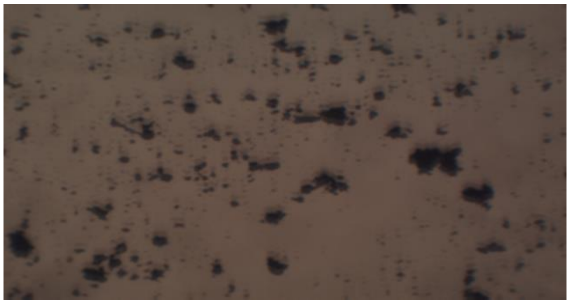
20mg of particles was then transferred into a beaker, then adding 10ml of water and shakes vigorously to obtain a homogeneous mixture after which the test was ran with the ultra-visible spectroscopy machine set at wavelength 190nm-900nm to obtain both the transmittance and reflectance results.

Then 2.0g of the remaining particles was collect with a beaker and was mixed with 2ml of H_2SO_4, 55ml of HN_3 and 8ml of Per-chloric acid, it was then digested during the process the solution was made with water to 100ml in other to obtain a standard concentration. After which the sample solution was divided into the number of test to be carried out for the characterization using the AAS machine.

RESULSTS AND DISCUSSION



X400

Figure 1: Micostructural Image of Limestone.

And if by approximate the smallest image of a microscope equals 1µm ($1x10^{-6}$m) therefore on applying the magnification equation as,

$$Magnification\ (m) = \frac{image\ distance}{object\ distance}\frac{v}{u}$$

The size of the limestone material will be mathematically obtained as expressed below the object size was determined.

Object distance = $1x10^{-6}$m/400 = $2.5x10^{-9}$ = 2.5nm

Table 1: Obtained Values of the Absorption Coefficient Squared and the Photon Energy at Various Absorbance and Wavelength from the Experimental Results

Wavelength (λ) (nm)	Absorbance (A)	Absorption Coefficient (α) m^{-1}	Absorption Coefficient Squared (α^2) m^{-2}	Photon Energy (E) eV
200	0.675	8.33×10^6	7.014×10^{11}	6.216
250	0.206	8.24×10^6	6.790×10^{11}	4.973
300	0.189	6.30×10^6	3.969×10^{11}	4.144
350	0.171	4.89×10^6	2.387×10^{11}	3.552
400	0.168	4.20×10^6	1.764×10^{11}	3.108
450	0.159	3.53×10^6	1.248×10^{11}	2.763
500	0.156	3.12×10^6	9.734×10^{10}	2.486
550	0.150	2.73×10^6	7.438×10^{10}	2.260
600	0.141	2.35×10^6	5.523×10^{10}	2.072
650	0.139	2.14×10^6	4.573×10^{10}	1.913
700	0.113	1.61×10^6	2.606×10^{10}	1.776
750	0.108	1.44×10^6	2.074×10^{10}	1.658
800	0.103	1.29×10^6	1.658×10^{10}	1.554
850	0.106	1.25×10^6	1.555×10^{10}	1.463
900	0.098	1.09×10^6	1.186×10^{10}	1.381

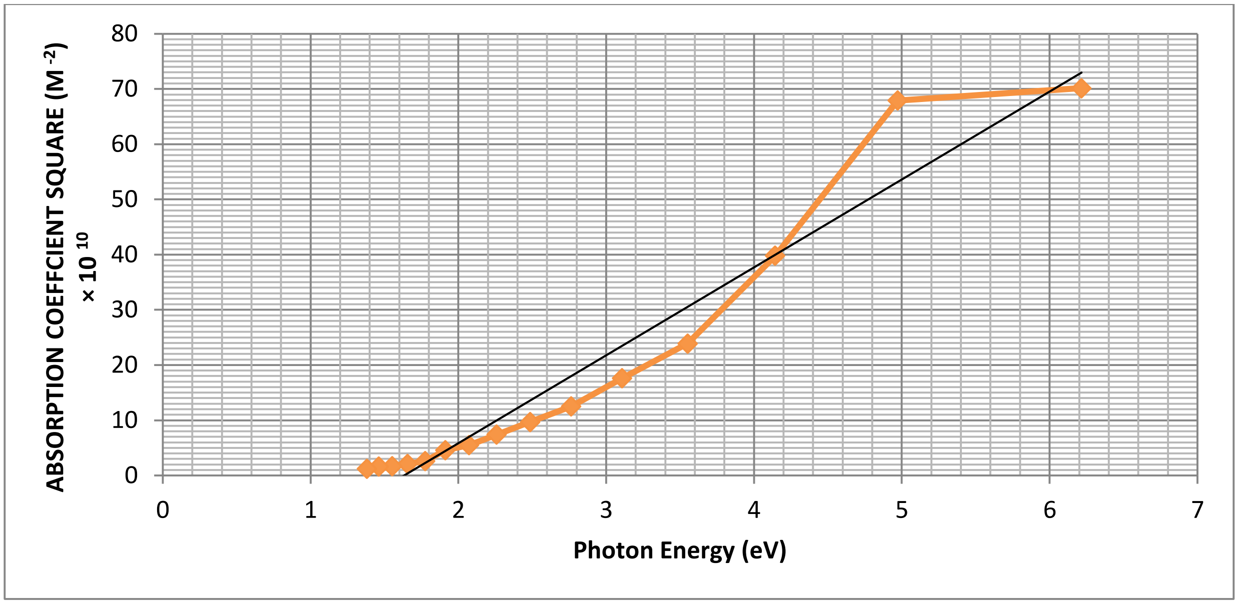


Figure 2: Graph of Absorption Coefficient Squared Versus Photon Energy.

From the graph the optical band gap of the limestone nanoparticles was obtained to be approximately 1.62eV; as deduced from the line of best fit. In other words we say that limestone is more an insulator then a semi- conductor material.

The AAS concentration result in ppm for each characterized metal element present in 2.0grams of limestone as deduced from the experiment. The tabulation below also contains its concentration in mg/mL. Which by conversion mg/L = ppm and 1mg/mL = 1000ppm.

Table 2: Limestone Elemental Concentration

Elements	Concentration in ppm	Concentration in mg/mL
Calcium (Ca)	31.13	0.031
Manganese (Mg)	21.11	0.0211
Iron (Fe)	21.09	0.021
Magnesium (Mn)	9.461	0.00461
Lead (Pb)	0.186	0.000186

In the result we observed that calcium has the highest concentration, as such conceals the maximum absorption. Also in the chemical composition it tends to displace every other element, since it predominates.

CONCLUSION

On this research study processing and characterization of limestone nanoparticle, as obtained from the micro stricture as the sample size is at nano-dimension. Limestone nanoparticles are found to absorb more photon when the incident photon wavelength is low. The limestone is requires more energy to get excited into the conduction band than the semi-conductor, as the optical band gap was found to be 1.62eV which is greater than the one of a semi-conductor materials. The elemental composition show that calcium is on more concentration than the other metal elements found in the limestone nanoparticle, as such displaces other during reaction.

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