



DOI:

10.22301/IJHMCR.2528-3189.102

Article can be accessed online on:

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SPECIAL ARTICLE

**INTERNATIONAL JOURNAL
OF HEALTH MEDICINE AND
CURRENT RESEARCH**

WATER CONTAMINATED CaCO_3 AND ITS OPTICAL PROCESS OF AGGREGATION

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ARTICLE INFO

Article History:

Received 10th July, 2016

Received in revised form

26th July, 2016

Accepted 23rd August, 2016

Published online 30th September,
2016

Key words:

CaCO_3 , Temperature, Water
Molecules, Microbubbles,
Contamination

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ABSTRACT

This paper reports an intensive study of water contaminated CaCO_3 and its optical process of aggregation by using an integrated simple electronic and optical devices system focusing on a simple integrated electronic system of time versus temperature and optical parameters measurements of transmittance, linear absorption coefficient and refractive index simultaneously. Our findings show the contaminated well water located about few kilometers from the beach area of Batu Merah Dalam, Ambon, Indonesia with a complex environmental problems of floods area has interesting physical properties in terms of its CaCO_3 aggregation process and bubbles formation during the heating temperature process from 35 to 100 °C. The process of aggregation formation increases as the temperature of the well water increases. While the refractive index of the system is mainly due to the bubble formation associated with a strong interaction of CaCO_3 aggregation process and the water molecules. This study contributes to an explanation of a strong scattering from microbubbles behavior in the physical liquid system.

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Citation: Hendry Izaac Elim (Elim Heaven)¹, Ronaldo Talapessy², and Nur Aida B. Retno Sari³ 2016 "Water Contaminated CaCO_3 and Its Optical Process of Aggregation", International Journal of Health Medicine of Current Research, 1, (01), 102-108.

INTRODUCTION

The main problem in human life is the water quality particularly related with its content quality which is consisting of chemical substances and its water size. On the other hand, the air pollutions due to CO and CO₂ as well as C-F gases may have widely influenced the whole earth atmosphere in which ¹²C atom here is the most active element which is very light and can move faster when there is action of the same particle or another atomic particles close to it [1-14]. The chemical substances in contaminated well water here could be a contaminated substance from external environment such as in small attractive islands areas of Maluku, Indonesia consisted of about 400 islands in its north part and about 1340 islands in the center and south east parts with the number of small islands in Aru area alone is ~59 % or ~800/1340 islands. The main chemical substance such as CaCO₃ has the main contribution in this unique province of Indonesia of ~1740 small islands sourced from many different types of a long natural process of various types of coral reefs and ocean animal shells. On the other hand, current advanced soft-drink technology have been widely accepted in modern society via the injection or the cooperation of another useful and healthy chemical substances into pure water. In this postmodern society in which advanced nanotechnology has been widely spread, the water molecule from tape water named as normal H₂O aggregated molecules can be reduced about 5-8 times smaller in order to move it much faster and easier into human body when they drink water so that this kind of water molecules can function as a healer in human body moving in the whole body. In this paper, one tries

to introduce a simple method to study unusual optical behavior of water contaminated CaCO₃ taken from a well of water located in a few kilometers distance from the sea area in a complex human housing in Batu Merah Dalam, Ambon, Indonesia. Time-temperature dependence of such water was characterized using a built up thermal sensor connected to a laptop via its USB port. While the optical properties of the water contaminated CaCO₃ was investigated under the influence of temperature linked to CaCO₃ aggregation process. By measuring the refractive index of each aggregation condition, we obtain that the optical behavior of this water contaminated CaCO₃ was mainly due to bubbles formation that covered each aggregation size in various different temperature. These findings suggest that such unusual optical properties might contribute to human advanced knowledge especially in water quality research and its various applications.

EXPERIMENTAL TECHNIQUE

Well water contaminated by CaCO₃ sample was taken from the area of Batu Merah Dalam, Ambon, Indonesia and then investigated using both simple experimental technique by incorporating an integration between a time measurement system sourced from computer device and temperature measurement system connected to a temperature sensor with the capability up to 100 °C, and an integrated microcontroller controlled using a software with a USB connector to laptop, and a separated optical measurement system linked with a USB microscope and a simple built up refractive index measurement system briefly depicted in Fig. 1.

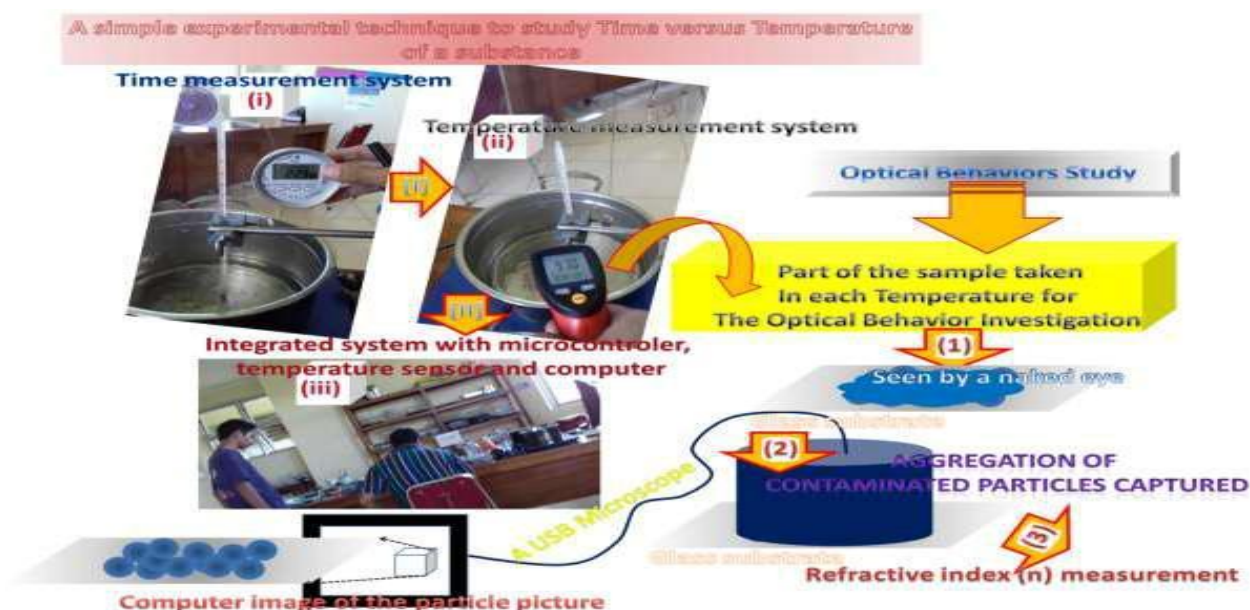


Figure 1. Three steps treatment to record an accurate data of time (t) versus temperature (T) in a substance: (i) Time measurement system, (ii) Temperature measurement system and (iii) Integrated system with microcontroller, temperature sensor and computer. While the optical behaviors measurement was also conducted simultaneously with at least 3 steps as follows: (1) Part of heated sample collected in different temperature, (2) a mobile USB microscope used to take the particle picture, and (3) Refractive index measurement was carried out to check the inner property of the substance.

In **Fig. 1**, one uses a double check measurement system in order to make sure the accuracy of this study. For example, the temperature measurement of the boiled well water contaminated by a main substance of CaCO_3 was measured not only by using one temperature sensor connected to an integrated electronic system, but also by direct measurement using an infrared thermometer.

RESULTS AND DISCUSSION

Figure 2 shows a typical character of well water contaminated by CaCO_3 substance. The time versus temperature behavior of the contaminated water indicates that as the temperature increases, the time of aggregation of CaCO_3 substance inside it increases as well. It is interesting to point out that when the temperature reaches $\sim 86^\circ\text{C}$, the CaCO_3 aggregation got saturation about 66 s, and then as the external T increased until reaching 100°C , there was a sudden decreased of temperature about 10°C just in 8 s.

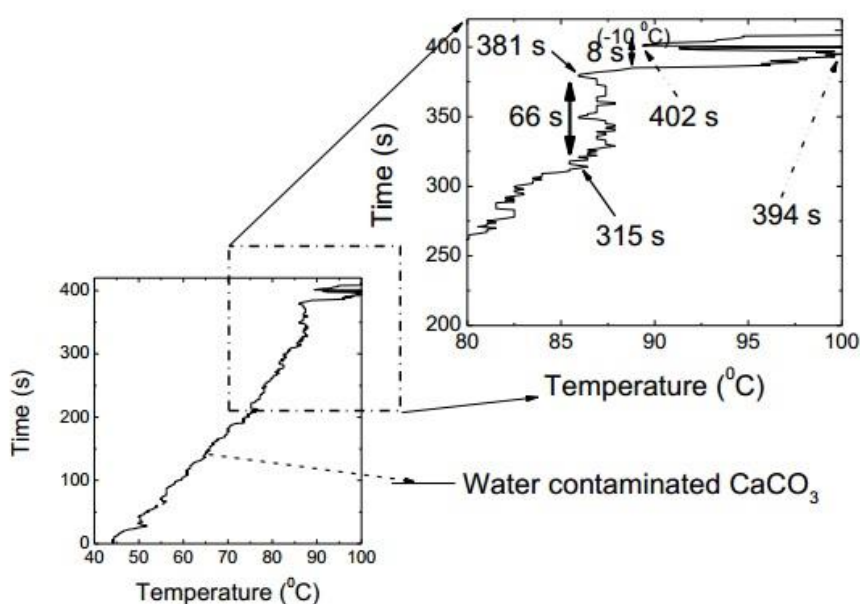


Figure 2. Character of time (t) versus temperature (T) of a well water (H_2O) contaminated with CaCO_3 . The inset is the enlargement of a particular behavior of the sample.

The aggregation process of CaCO_3 in the well water captured by a mobile USB microscope connected to a laptop is shown in **Fig. 3**. According to the observation data, one can see that as the temperature of the well water increases, more CaCO_3 aggregation is obtained. Furthermore, the size of the aggregation formation inside the water is enlarged. This picture significantly indicates that the power of temperature increment can directly move a very small CaCO_3 substance inside the well water one another, and then they interact each other to form bigger aggregation.

Therefore, the use of this simple technique is applicable to study an aggregation process of a sample in liquid sample just like the contaminated well water. It is interesting to note that at 65°C , there are a lot of CaCO_3 aggregation is formed separately in different positions inside the water. Moreover, as the heating temperature is increased, these kinds of small size of CaCO_3 aggregations attach one another in their close interactions and then form a few bigger aggregation starting from 75°C to 100°C .

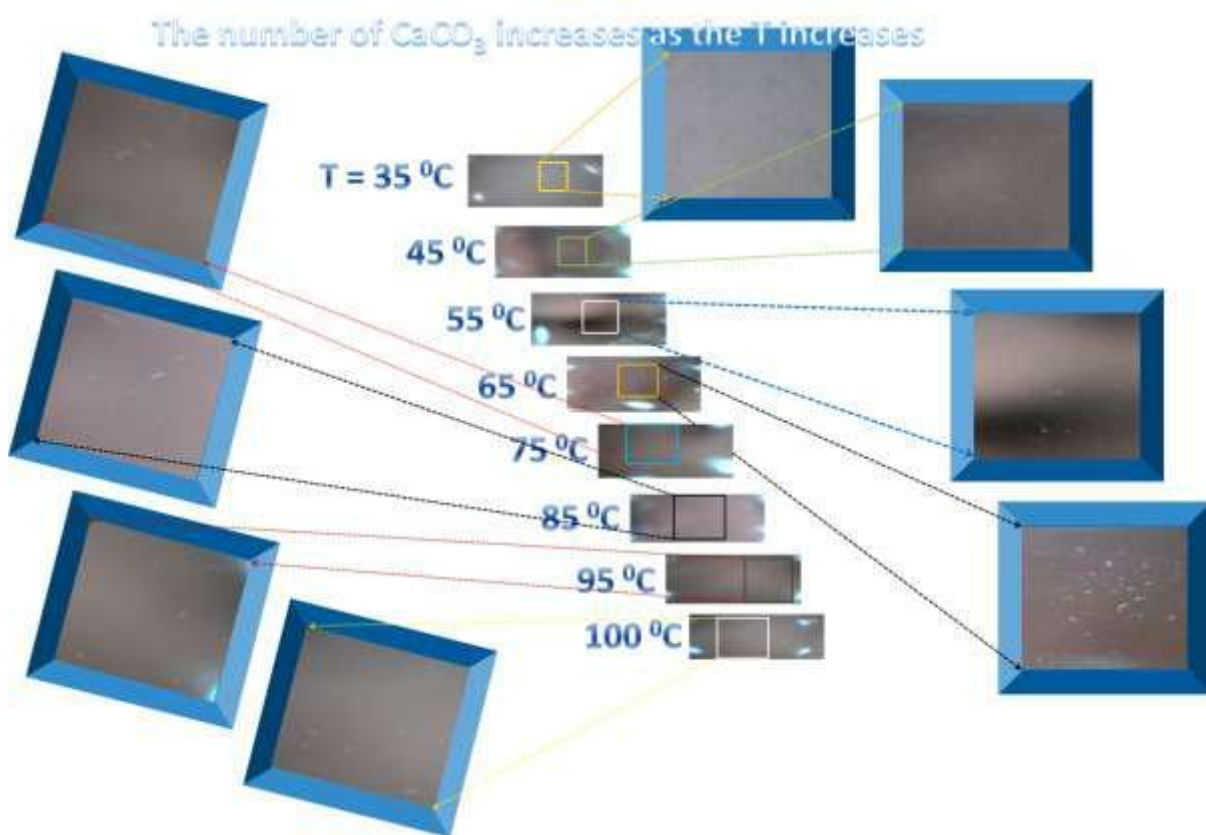


Figure 3. Aggregation behavior of CaCO_3 inside the contaminated well water as the temperature of the water increased up to 100°C .

Table 1 depicts the important optical parameters data of contaminated by CaCO_3 which are under the influence of heating temperature such as transmittance (T),

linear absorption coefficient (α), and refractive index (n) measured with two different wavelengths of 532 and 650 nm, respectively.

Table 1. Measurement of optical parameters of water contaminated by CaCO_3 in various temperature ranging from 35 to 100°C .

T ($^\circ\text{C}$)	Wavelengths (nm)	T (100%)	α (cm^{-1})	n
35	532	55.0	10	0.85
	650	56.9	9	0.97
45	532	52.2	11	0.97
	650	65.4	7	0.99
55	532	60.9	9	0.92
	650	69.8	8	0.99
65	532	68.3	6	0.95

	650	81.8	3	0.92
75	532	66.4	7	0.92
	650	54.9	10	0.99
85	532	59.3	6	0.97
	650	81.8	3	0.92
95	532	53.7	10	0.92
	650	72.7	5	0.91
100	532	57.1	9	0.99
	650	55.5	10	0.91

From the various data shown in **Table 1**, one can figure out the characters of particular behaviors of this well water contaminated CaCO_3 as depicted in **Fig. 4**. The average transmittance of the contaminated water is ranging from ~52 to ~82 %. The largest T is found by using 650 nm wavelength measurement at 65 and 85 °C, respectively. However, at the same condition, the transmittance of the same sample has a different

transmittance about 9 degree Celcius measured at $\lambda = 532$ nm. Such finding contributes to the sensitivity of the CaCO_3 aggregation formation to green laser light (532 nm). Such findings are also supported with the α measurement as shown in **Fig. 4(a)** and the t vs. T character in **Fig. 1**.

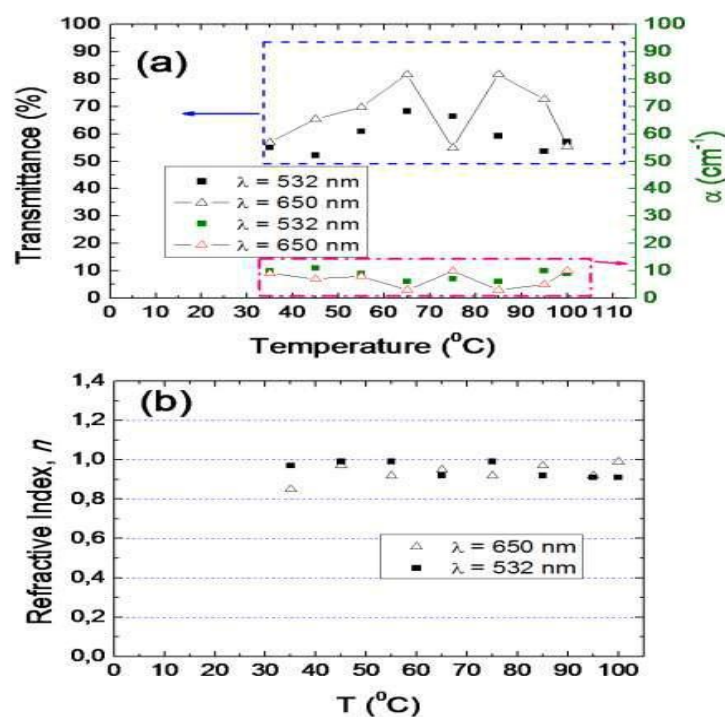


Figure 4. (a) Optical behavior based on the transmittance (T) and linear absorption coefficient (α) of well water contaminated with CaCO_3 aggregation investigated with two different wavelengths ($\lambda = 532$ nm and 650 nm). (b) The main contribution of the optical properties is due to the bubble formation in the system with the significant indicator from $n < 1$ smaller than the refractive index of water.

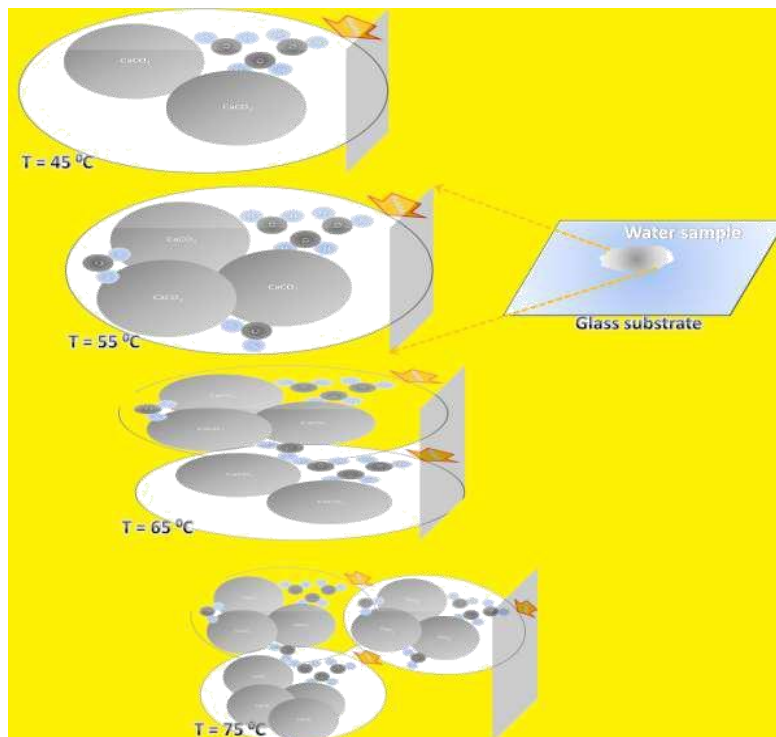


Figure 5. A proposed illustration of the explanation about the optical attitudes of the well water contaminated by the aggregation CaCO_3 -temperature dependence.

Figure 4(b) shows the refractive index behavior of the contaminated water measured in different temperature. It points out that the average n of the system is about 0.91 – 0.99 or smaller than n of water. This indicates that such optical properties are mainly contributed by bubbles formation or many gas particles existed due to a very strong interaction between CaCO_3 formation and water molecules. Figure 5 describes a propose explanation of such behavior. From the n measurement at two different wavelengths of 532 nm and 650 nm as listed in **Table 1**, one can see that these kinds of bubbles are stable and mainly contributing to the refractive index of the optical system. Based on our

formal intensive investigation on the optical limiting and nonlinear optical properties of various carbon nanomaterials such fullerene derivatives [5,6,13], carbon nanoballs [7,8], multiwalled carbon nanotubes (CNT). [11], dan coated multiwalled CNT with metallics or semiconducting particles [14], the nonlinear optical behaviors were due to bubble formation of the nanomaterials inside various solvents such as toluene, water, DMF and THF. Therefore, the largest contribution of the optical properties in the bubbles formation of the contaminated CaCO_3 water can cause a large scattering in such physical system which is similar to that in the carbon nanoparticles system [5-8, 11,13-14].

CONCLUSION

In conclusion, water contaminated CaCO_3 and its optical process of aggregation have been intensively studied by using a simple technique with the incorporation of a simple integrated electronic system of time versus temperature and optical parameters measurements of transmittance, linear absorption coefficient and refractive index simultaneously. We obtain that the contaminated well water located about few kilometers from the ocean of Batu Merah Dalam, Ambon, Indonesia with a complex environmental problems of

floods area has interesting physical properties in terms of its CaCO_3 aggregation process and bubbles formation during the heating temperature process from 35 to 100 °C. The process of aggregation formation increases as the temperature of the well water increases. While the refractive index of the system is mainly due to the bubble formation associated with a strong interaction of CaCO_3 aggregation process and the water molecules. This study suggests a strong scattering from microbubbles bahavior which needs further detail research in the future for a

better understanding about this complicated liquid system.

ACKNOWLEDGMENT

We would like to grateful for a special thanks to our research students working in different projects in our **PPNRI-LEMLIT**, Pattimura university, Indonesia for their hard workings and supports during the process and transformation of this development of our knowledge contributed to international scientific communities.

REFERENCES

1. H.I. Elim, Y.W. Zhu, and C.H. Sow, Length Dependence of Ultrafast Optical Nonlinear in Vertically Aligned Multiwalled Carbon Nanotube Films, *J. Phys. Chem. C* **2016**;120(31):17733-17738.
2. Bin Cai, Okihito Sugihara, Hendry I. Elim, Toshikuni Kaino, and T. Adschiri, A Novel Preparation of High-Refractive-Index and Highly Transparent Polymer Nanohybrid Composites, *Applied Physics Express* **4** (2011) **092601**.
3. Hendry I. Elim, Bin Cai, Okihito Sugihara, Toshikuni Kaino, and T. Adschiri, Rayleigh scattering study and particle density determination of high refractive index TiO₂ nanohybrid polymer, *Phys. Chem. Chem. Phys.*, **2011**;13 (10): 4470 - 4475.
4. Hendry I. Elim, Bin Cai, Yu Kurata, Toshikuni Kaino, Okihito Sugihara, Tadafumi Adschiri, Ang-Ling Chu, and Nobuyuki Kambe, Refractive index control and Rayleigh scattering properties of transparent TiO₂ nanohybrid polymer, *J. Phys. Chem. B* **2009**; **113** (30): 10143–10148.
5. Hendry I. Elim, Sea-Ho Jeon, Sarika Verma, Wei Ji, Loon-Seng Tan, Augustine Urbas, and Long Y. Chiang, Nonlinear Optical Transmission Properties of C₆₀ Dyads Consisting of a Light-Harvesting Diphenylaminofluorene Antenna, *J. Phys. Chem. B Letters* **2008**;112:9561-9564.
6. Hendry I. Elim, Robinson Anandakathir, Rachel Jakubiak, Long Y. Chiang, Wei Ji and Loon-Seng Tan, Large concentration-dependent nonlinear optical responses of starburst iphenylaminofluorenocarbonyl methano[60]fullerene pentads, *J. Mater. Chem.* **2007**; **17**: 1826.
7. M. Bystrzejewski, H. Lange, A. Huczko, H.I. Elim, W. Ji, Study of the optical limiting properties of carbon-encapsulated magnetic nanoparticles, *Chem. Phys. Lett.* **2007**; **444**: 113-117.
8. G .X. Chen, M. H. Hong, L. S. Tan, T. C. Chong, H. I. Elim, W. Z. Chen and W. Ji, Optical limiting phenomena of carbon nanoparticles prepared by laser ablation in liquids, *J. Phys.: Conf.Ser.* **2007**; **59**: 289-292.
9. Boon-Kin Pong, Hendry I. Elim, Jian-Xiong Chong, Wei Ji, Bernhardt L. Trout and Jim-Yang Lee, New Insights on Nanoparticle Growth Mechanism in Citrate-Reduction of Gold(III) Salt: Formation of Au Nanowire Intermediate and its Nonlinear Optical Properties, *J. Phys. Chem. C* **2007**; **111**: 6281.
10. Y. J. Liu, X. W. Sun, H.I. Elim and W. Ji, Effect of liquid crystal concentration on the lasing properties of dye-doped holographic polymer-dispersed liquid crystal transmission gratings, *Appl. Phys. Lett.* **2007**; **90**: 011109.
11. Kok Chung Chin, Amarsinh Gohel, Hendry Izaac Elim, Weizhe Chen, Wei Ji, Ghee Lee Chong, Chong Haur Sow, Andrew T.S. Wee, Modified carbon nanotubes as broadband optical limiting nanomaterials, *Journal of Materials Research* **2006**; **21**(11): 2758-2766.
12. Yanwu Zhu, Hendry Izaac Elim, Yong-Lin Foo, Ting Yu, Yanjiao Liu, Wei Ji, Jim-Yang Lee, Zexiang Shen, Andrew Thye-Shen Wee, John Thiam-Leong Thong, and Chong-Haur Sow, ZnO Nanoparticles Beaded Multiwalled Carbon Nanotubes: For Ultrafast Nonlinear Optical Switching, *Advanced Materials* **2006**; **18**(5): 587-592.
13. H. I. Elim, Jianying Ouyang, Suat Hong Goh, and Wei Ji, Optical limiting based materials of mono-functional, multi-functional and supramolecular C60-containing polymers, *Thin Solid Film* **2005**;477:63-72.
14. Kok Chung Chin, Amarsinh Gohel, Weizhe Chen, Hendry Izaac Elim, Wei Ji, Ghee Lee Chong, Chong Haur Sow, Andrew Thye Shen Wee, Gold and Silver Coated Carbon Nanotubes: An Improved Broad-band Optical Limiter, *Chem. Phys. Lett.* **2005**; **409**: 85-88.
