High Accuracy of Gold Density Measurement by Using Hydrostatic Weighing Method

By : Mohd Fazrulhisyam Mohd Nor

Introduction

Density of a material is determined by mass per unit volume of the material. It can be stated in grams per millilitre (g/ml) or in the SI unit system in kilograms per cubic meter (kg/m^3). The purpose of measuring density of a material is to maintain its quality control, concentration, determination and also purity of precious metals. Gold is one of precious metals. It is important to determine its purity because the value of gold depends on it. Figure 1 shows types of gold available in the market that is of 24 carat, 22 carat, 18 carat, 14 carat, 12 carat and 10 carat. The purity of gold will be less of value if there is reduction in the density of gold. The gold density is 19.3 g/ml at purity of 24 carat.

Figure 1: Example of jewellery in Malaysian market

Figure 2 : Densimeter

The hydrostatic weighing method applied to determine the density of gold. Figure 2 shows a densimeter used in this method to measure the gold density and determine the gold purity.This instrument is commonly used in pawn shops, bank agencies and jewellery shops to check the gold purity. This method is economical, however, its accuracy to measure the gold density is inaccurate due to the uncertainty of densimeter is 0.1 g/ml. Distilled water is used as a standard liquid in densimeter. The gold is weighed in air and immersed in the distilled water. Then the densimeter will show the purity of gold based on density measurement calculation.

The purpose of this research is to improve the measurement of gold density using hydrostatic weighing method. The hydrostatic weighing method works based on Archimedes' principle. This method can determine the density of gold without destructing it. Anyhow, there are criteria involved in this method that should be improved to obtain an accurate measurement results. The standard liquid used was changed from distilled water to tridecane. The tridecane temperature was maintained at 20 °C. The density of tridecane was traceable to a standard solid density calibrated by National Metrology Institute. The tridecane is also known to have a low surface tension. Figure 3 summarizes the traceability of the gold density. The technique used to measure the mass of gold was also improved due to gold porosity. Measurement of gold mass is done by comparison method between standard weight and the gold sample. This method has made an improvement as compared to densimeter in terms of accuracy, uncertainty and standard liquid used.

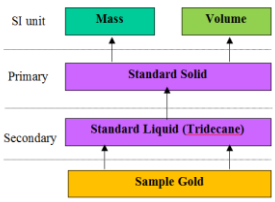

Figure 3: Traceability of the gold density

Results and discussion

Gold sample was measured using a hydrostatic weighing system. Figure 4 shows the measurement results of the gold sample (Serial Number: 026552, weight 20 g, purity 24 carat) that was used for evaluation purposes. The gold density against number of measurement graph was plotted to illustrate the repeatability of the measurement. All data taken at each measurement point was plotted and the expanded uncertainty of the measurement is 0.001 g/ml. The average density of the gold sample (Serial Number: 026552) is 18.811 g/ml.

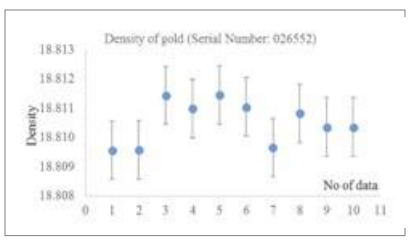

Figure 4 : Measurement results of gold density using hydrostat weighing method

Conclusion

An improved hydrostatic weighing system has been successfully developed using tridecane and standard weight. The density of tridecane has been determined using disc weight that is traceable to KRISS. This system weighed the gold sample by immersing the sample in the tridecane. The expanded uncertainty evaluated in this hydrostatic weighing system is 0.001 g/ml. This method is proved to be more precise as compared to 0.1 g/ml expanded uncertainty acquired by densimeter. The most important is, this system is traceable to the base unit of mass and length.

Observation and Comparison of Multiwavelength Generation Erbium Doped Fibre Ring Laser Utilising Photonic Crystal Fibre With Zero Dispersion at 1040nm and 1550 nm

By : Dr. Mohd Nizam Abdullah

Abstract

We conducted an experiment to demonstrate the generation of multi wavelength by incorporating fibre Bragg gratings (FBGs) and photonic crystal fibre (PCF) which has zero dispersion of 1040 nm and 1550 nm in erbium doped fibre ring laser (EDFRL). The multiwavelength was generated at gain bandwidth EDFRL setup. The results showed a good agreement of less than 0.03 % of peaks wavelength generation based on both experimental set-up. The set-up also shares good repeatability of peaks wavelength generation of 0.01 nm and power deviation of 0.15 dBm. Nevertheless, experimental set-up with PCF of ZDW at 1550 has generated multi wavelength phenomenon by 30% effectively compared to PCF with ZDW at 1040 nm by 30% effectively. The results produced an impactful finding whereby the multiwavelength was clearly observed.

Results & Discussions

As result shown in figure 1(a), it exhibits the multi wavelength spectrum generated through this arrangements at which has peak wavelengths positioned at ω1 (1530.480 nm, -37.19 dBm), λ1 (1531.450 nm, -30.81 dBm), λ2 (1531.800 nm, -30.48 dBm), λ3 (1532.300 nm, -26.13 dBm), ω2 (1532.835 nm, -21.15 dBm), λ4 (1533.245 nm, -33.02 dBm), λ5 (1533.715 nm, -39.08 dBm) and ω3 (1535.025 nm, -39.44 dBm). Coincides with the spectrum gain, sufficient power stimulates the multi wavelength phenomenon within the range. Multi wavelength lasing was generated in this oscillation with a constant spacing of FBGs and assisted by FWM process which exterminate photons from the lasing to create new photons at different wavelengths. This continuous effect does stimulate EDFRL and amplified the process. Subsequently, the lasing wavelengths represent the effects of each FBGs and the nonlinear effect of assisted by FWM.

In this situation, sufficient power gain of EDFRL which oscillates in the cavity as required for FWM process to generate additional lasing. The phenomenon easily generated at power output at 80 mW. Meanwhile, through the same experimental set-up but with application of PCF ZDW at 1040 nm, the spectrum output as shown in figure 1(b). The peak wavelengths positioned at ω1 (1530.425 nm, -37.93 dBm), λ1 (1531.635 nm, -32.79 dBm), λ2 (1532.000 nm, -31.538 dBm), λ3 (1532.660 nm, -32.02 dBm), ω2 (1532.840 nm, -36.03 dBm), λ4 (1533.110 nm, -32.94 dBm), λ5 (1533.545 nm, -31.12 dBm) and ω3 (1535.020 nm, -39.17 dBm).

In order to stimulate multi wavelength phenomenon through the set-up, 115mW was pumped into the configuration. More power is required to pump into the configuration in order to excite multi wavelength generation. This is due to the mismatch of PCF ZDW at 1040 nm applied into 1550 nm of the transmission wavelength of the configuration. As a result, an increment 30% of power is required to match PCF ZDW 1550 nm set-up and to encourage new signals occurrence of signals pump diffraction through aperture of PCF ZDW at 1040 nm. Conversely, the power of FBG1 signal declined nearly 6 % in turn to generate five new signals with multiple power output displayed at average at -34 dBm. It and also decrease the power of FBG2 and FBG3 signals to 41% and 0.7 % respectively. We also extend our experiments by monitoring peaks wavelength and the stability output on both experimental set-up at period of 160 minutes at temperature of 22ºC±3°C and relative humidity of 60%±10%. Through the findings, the agreement of peaks wavelength generated on both set-up is less than 0.03% as shown in Table 1. Based on figure 2, the repeatability of the wavelength was excellent with an average deviation of 0.02 nm and power deviation of 0.13 dBm.

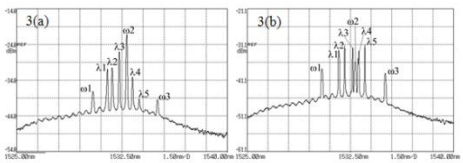

Fig. 1. EDFRL generated spectrum which produced multi wavelength through the experimental setup with PCF ZDW at (a) 1550 nm and (b) 1040 nm

PCF ZDW 1550 nm	PCF ZDW 1040 nm	Ratio
1530.430	1530.425	1.000003
1531.450	1531.635	1.000121
1531.800	1532.000	1.000131
1532.300	1532.660	1.000235
1532.835	1532.840	1.000003
1533.245	1533.110	1.000088
1533.715	1533.545	1.000111
1535.025	1535.020	1.000003

Table 1. EDFRL generated peaks wavelength through the experimental setup with PCF ZDW at 1550 and 1040 nm

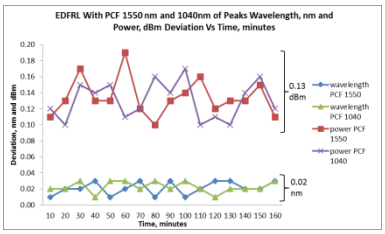

Fig. 2. Peaks wavelength and power deviation output based on 160 minutes duration

Conclusions

Through this comparative study, we concluded that the agreement of peaks wavelength generated through application of EDFRL via PCF ZDW at 1550 nm and 1040 nm is 0.03 %. The repeatability which portrayed the stability performance on both experiments of peaks wavelength with an average deviation of 0.02 nm and power deviation of 0.13 dBm. More power at 30% incremental is needed to stimulate multi wavelength phenomenon at EDFRL using PCF ZDW at 1040 compared to PCF ZDW at 1550 nm. This setup has achieved remarkable results by producing multi wavelength signals using FBGs and PCF with zero dispersion mismatch from transmission window based on EDFRL.

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Functionalization by Acidic Treatment in The Purification of Multiwalled Carbon Nanotubes (MWCNTs)

By : Mohamad Fauzi Ahmad

Introduction

The chemical and thermal stabilities, electronic properties, high tensile strength and ultra-light weight are the main features of multi-walled carbon nanotubes (MWCNTs). MWCNTs normally come with purity degree of only less 95%. The purity can be increased by removing the particles of carbonaceous materials (amorphous carbon particles, fullerenes and nanocrystallinepolyaromatic shells) and metal catalysts (generally compounded by Co, Ni or Fe) using refluxing process.

Comparative studies of two multi-walled carbon nanotubes (MWCNT) from different manufacturers were reported in this paper. The purification and functionalization of commercial multi-wall carbon nanotubes were investigated. MWCNTs were treated with boiling concentrated HNO_3 under a reflux condenser for 2 hours at 100 °C in order to purify and oxidize the raw material. The oxidized MWCNTs were rinsed with de-ionized water until the filtrate pH stabilized. Measurement technique used was by applying the thermo gravimetric analysis (TGA) for thermal analysis decomposition products and at the same time, the chemical shifted in MWCNTs can be determined by using Raman Spectroscopy.

Results and discussion

Different MWCNTs were analysed using Raman Spectroscopy and Thermo gravimetric analyser (TGA). Figure 1 and Table 1 show the Raman spectra for Skyspring and Baytubes.

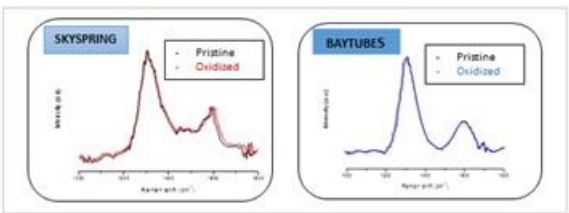

Figure 1: Raman spectra for Skyspring and Baytubes, before (pristine) and after (oxidized) acid treatment.

The Raman shift (cm^{-1}) and the I_D/I_G ratio for nitric acid modified MWCNTs samples				
Samples		Raman shift (cm^{-1})		I_D/I_G
		D	G	
Skyspring	Pristine	1318.06	1593.38	1.30
	Oxidized	1310.62	1580.23	1.32
Baytubes	Pristine	1304.91	1591.48	1.31
	Oxidized	1303.41	1590.31	1.34

Table 1: The Raman shift (cm^{-1}) and the ID/IG ratio for Skspring and Baytubes; Before & after acid treatment

Figure 1 shows the Raman band of defect (D) & graphitic (G) structure of samples.

The intensity ratio, ID/IG of both samples was slightly changed after acid treatment and it was demonstrated by the formation of structural defects on the MWCNTs as shown in Table 1.

For both Figure 1 and Table 1, Raman Spectra of Pristine and Oxidized for MWCNT Skyspring and Baytubes were slightly moved.

Sample	% of impurity		% of Different
	Pristine	Oxidized	
Skyspring	98.5898	99.1014	0.5116
Baytube	96.9348	98.2082	1.2734

Table 2: The TGA analysis result on the left shows the % of impurity for Skspring and Baytubes, before & after acid treatment.

Based on Table 2, it shows that the purity of MWCNT is slightly increased after purification process**.** The purity of MWCNT had been improved due to purification process.

TGA analysis also proved that the acid treatment of Oxidized Baytube sample has strongly enhanced the percentage of purity as compared to Oxidized Skyspring sample.

Conclusion

Functionalization of MWCNTs has been achieved via acidic treatment. Two different types of MWCNTs from different sources were studied. Raman spectra showed that the D- and G band were shifted in Oxidized Baytube and vice versa for Oxidized Skyspring. TGA analysis showed the acid treatment of Oxidized Baytube sample eliminated the metal catalyst as compared to Oxidized Skyspring sample which was not changed after the treatment. For both analyses, Baytube MWCNTs are more stable compared to Skyspring MWCNTs.

Software Manipulative Techniques of Protection and Detection : A Review

By : Muhamad Azwan Ibrahim

Introduction

In the digital era, everything is now relies on software. Software plays an important part in banking, trades, medical, production, entertainment and education. Software vulnerability leads to software piracies, code stealing and software tampering. This does not only affecting the software industries, but can caused more troubles such as in economic and legal situation, where people nowadays tend to tamper or manipulate software in the favours of their purposes in every sectors.

Illegal manipulation of software is one of the biggest issues in software security. There have been a lot of extensive studies related to the software security such as steganography, obfuscation, watermarking, birthmarking and many more. Some of them have existed in literatures from the studies done years ago, but are still being practiced until today.

There are numbers of real life cases where tampering could be a serious threat to community, for instance; a case as of petrol station in Silibin, Ipoh has been reported in the year of 2013 by the Malaysian enforcement authority where the owner had manipulated their fuel pumps to gain more profit. Similar cases also had been reported in India in the year of 2008.

Several studies and techniques are applicable to prevent such problems. This article summarizes techniques applicable conducted from the previous studies.

Steganography

Steganography defined as the method of hiding information by using innocuous carriers by means of covering the existence of the secret information. The word steganography itself was derived from ancient Greek, which means to cover or hide. It is not intended to replace cryptography but rather to complement it. By concealing information with encryption, it will reduce the chances of the information being revealed.

Obfuscation

Obfuscation is a technique to complicate the control flow of an instruction stream and data structures which contain sensitive information to mitigate from code reverse engineering. Although an adversary has successfully revealed the code, whether in the form of original source code or assembly, it would be very difficult to understand the flow and thus reduce the likelihoods of the code being reverse-engineered.

Software Watermark

Software watermarking can be defined as the process of embedding additional information into software, without interrupting the functionality of the software itself.
The first patents based on the concepts of software watermarking were filed in 1994. The watermarking proposed was used to identify unauthorized copies along with the source.
In 1996 Microsoft Corporation has filed a patent which utilizes software watermarking concepts. This was done by reorganizing blocks of codes so that the code blocks become a unique identification on each software distribution.

Fingerprinting

Fingerprinting concepts is basically same as watermarking, except that fingerprinting embeds unique identifier information on each distribution copies of software. This may not only detect an occurrence of software violation copies, but also able to trace the violator. A fingerprint may include vendor, product or customer information.

Software Birthmark

Software birthmark is one of the rarely used methods on securing a copy of software. It has quite a different approach compared to software watermark. The general concept of software birthmark is as found in the computer virus signature concepts; to produce a unique identification of the software. There are two important characteristics to differentiate between the software watermark and software birthmark;

(a) In software watermark, it is often necessary to embed external information, data or code within carrier software, whereas it is not required in software birthmark.

(b) Birthmark could not be used to identify ownership, or source of distribution but rather to confirm that software or code whether it is in partially or in fully, is a reproduction of others.