

References

1. Sedriks, A. John. Corrosion of stainless steel. 2nd edition, New York: John Wiley & Sons, Inc., 1996.
2. Jones, D. A. Principles and Prevention of Corrosion. New York: Macmillan Inc., 1992.
3. Fontana, Mars G. Corrosion Engineering. 3rd edition, New York: McGraw-Hill, 1986.
4. Streicher, M. A. ASTM STP 656, p. 3, 1978. Reprinted in Process Industries Corrosion. Moniz, B. J. and Pollock, W. I. eds., NACE, Houston, 1986, p. 123.
5. Payer, J. H., Berry, W. H. and Boyd, W. K. ASTM STP 610, p. 82, 1976. Reprinted by permission, American Society for Testing and Materials.
6. Parkins, R.N. "Stress Corrosion Cracking-The Slow Strain Rate Technique", ASTM STP 665, 1979, p. 5.
7. Akuezue, H. C. and Verma, S. K. Advanced Materials & Process. 3(1992), pp. 26-30.
8. Smith, William F. Structure and properties of engineering alloys. 2nd ed. New York: McGraw-Hill, 1993.

9. Hall, Ernest L. and Briant, Clyde L. "Chromium depletion in the vicinity of carbides in sensitized austenitic stainless steels". Metallurgical Transactions A, vol. 15A (May), 1984, pp. 793-811.
10. Callister, William D., Jr. Materials science and engineering an introduction. 3rd ed. New York: John Wiley&Sons, Inc., 1994.
11. Corwan, R.L. II and Gordon, G. M. "Proc. Conf. Stress Corrosion Cracking and Hydrogen Embrittlement" NACE, Houston, TX, 1977, p. 1025.
12. Thorvaldsson, T. and Salwan, A. Scripta Metallurgica, vol. 18, 1984, p. 739.
13. Stawstrom, C. and Hillert, M. Journal of iron instrument, vol. 207, 1969, pp. 77-85.
14. Andreson, P. L., Ford, F. P., Murphy, S. Ms "State of knowledge of radiation effects on environmental cracking in light water reactor core materials". Proceedings of the Forth International Conference on Environmental Degradation of Materials in Nuclear Power Systems Water Reactors, NACE International, Houston, TX, 1989, p. 1.
15. Jacobs, A. J. and Wozadlo, G. D. Journal of Materials Engineering, vol. 9, No. 4, 1988, p. 345.
16. Graver, D. L. ed. Corrosion data survey, Metals Section. 6th ed. NACE, 1985.
17. Speidal, M. O. Metallurgical Transactions A, vol. 12A, 1981, p.779.
18. Kowaka, M. and Kudo, T. Transactions of the Japan Institute of metals, vol. 16. 1975, p. 385.

19. Valen, S. and Gartland, P. O. "Crevice Corrosion repassivation temperatures of highly alloyed stainless steels". Corrosion Science. vol. 51. No. 10 (October), 1995, pp. 750-766.
20. Schmidth, Charles G., Caligiuri, Robert D., Eiselstein, Lawrence E., Wing, Sharon S. and Cubiciotti, D. "Low temperature sensitization of type 304 stainless steel pipe weld heat affected zone". Metallurgical Transactions A, vol. 18A (August) 1987, pp. 1483-1493.
21. Anderson, P.L., "Effect of transients in water chemistry, temperature, and loading on intergranular stress corrosion cracking of AISI 304 stainless steel". NACE. Vol. 42, No. 3, (March), 1986, pp. 169-179.
22. Sprowls, D.O. Metal Handbook, vol. 13, Corrosion, 9th ed. ASM International, Metal Park, OH, 1987, p. 273.
23. Gutzeit, J., Merrick, R.D., and Sharfstein, L.R. Metals Handbook. Vol.13, Corrosion. 9th ed. ASM International. Metal Park, OH, 1986, p. 1262.
24. Dhawale, S. Cragolino, G., and MacDonald, D.D. EPRI Progress Report RP1166-1, July-December, 1980.
25. Isaacs, H.S., Vyas, B., and Kendig, M.W. "The stress corrosion cracking of sensitized stainless steel in thiosulfate solutions". Corrosion-NACE. Vol.38. (1982), pp. 130-136.
26. Berge, Ph. And Donati, J.R. Nuclear technology. Vol.55, (1981), p. 88.
27. Newsletter on Three Mile Island Unit 1. Nuclear News. Vol.25. (March), 1982, p. 47.
28. Newman, R.C. and Sieradzki, D.D. Corrosion Science (in press).

29. Cragnolino, G. and MacDonald, D.D. Corrosion. vol.38(1982), p. 406.
30. Farrer, T.W. and Wormwell, F., Chem. Ind. Vol. 5 (January), 1953, p. 196.
31. MacDonald, D.D., Robert, B., and Hyde, J.B. Corrosion Science. Vol. 18 (1978), p.411.
32. Zucchi, F., Frignani, A., Trabancchi, G., and Zuchini, M., La Metallurgia Italiana, No.2 (1979), p. 48.
33. Zucchi, F., Frignani, A., Trabancchi, G., and Zuchini, M., La Metallurgia Italiana, No.4 (1976), p. 188.
34. Ahmad, S., Mehta, M.L., Saraf, S.K., and Saraswat, I.P., Corrosion, vol. 37, 1981, p. 412.
35. Piehl, R.L., J. Am. Pet. Inst. vol.44, No. 3, 1964, p.189.
36. Hart, A.C., Br. Corrosion J. vol. 6 (1971), p. 164.
37. Denhard, E.E. and Gaugh, R.R., Stress corrosion testing, ASTM STP-425, American Society for testing and Materials, Philadelphia, 1967, p. 41.
38. Magnin, T. and Lepinoux, J. "Metallurgical aspects of the brittle SCC in austenitic stainless steels". Parkins Symposium an Fundamental aspects of stress corrosion cracking. Pennsylvania. TMS, 1992, p. 41.
39. Maeda, N. et al. "Application of Positron Annihilation Line-shape Analysis to Fatigue Damage for Nuclear Plant Material". Nuclear Engineering and Design. 167(1996), pp. 169-174.

40. Sawatewacharkul, P. Measurement of Degree of Sensitization in Stainless Steel Using Doppler Broadened Positron Annihilation Spectroscopy. Master's Thesis, Department of Nuclear Technology, Graduate School, Chulalongkorn University, 1998.
41. Connors, D.C. and West, R.N. "Positron annihilation and defects in materials". Phys. Letter. 30A (1969), pp. 24-25.
42. Cambell, J.L. "Annihilation Gamma-ray Lineshape Parameter". Appl. Phys. 13 (1977), pp. 365-369.
43. Hara, T., and Schaffer, J.P. "An improved method for using Doppler-broadened positron annihilation spectroscopy for the study of the electronic properties of materials". J. Phys. E.: Sci. Instrum. 21 (1988), pp. 595-600.
44. Jargelius, R.F.A., Hertzman, S., Symniotis, E., Hanninen, H., and Aaltinen, P. Corrosion. Vol. 47 (1991), p. 429.
45. Advani, A.H., Murr, L.E., Atteridge, D.G., Chelakkara, R. Metallurgical Transactions A. Vol.22A (1991), p. 2917.
46. Bennet, B.W., Pickering, H.W. Metallurgical Transactions A, vol. 18A (1987), p. 1117.
47. Wells, D.B., Stewart, J., Herbert, A.W., Scott, P.M. and Williams, D.E. "The use of percolation theory to predict the probability of failure of sensitized, austenitic stainless steel by intergranular stress corrosion cracking". Corrosion. Vol. 45, No. 8, 1989, pp. 649-660.
48. Champion, F.A. Symposium on Internal stresses in Metals and Alloys, Inst. Metals. London, 1948, p. 468.
49. Logan, H.L. J. Res. Natl. Bur. Stand. Vol.48, 1952, p. 99.

50. "Primary Side SCC in Japanese PWR Plants S/G Tubing". Mitsubishi Heavy Industries, Ltd. Presented at the EPRI Workshop on Primary Side SCC and Secondary Side SCC and IGC of PWR Steam Generator Tubing, Clear water Beach, Florida, 1983.



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Appendix I

CONFIGURATION OF SLOW STRAIN RATE TENSILE TESTING MACHINE

AI.1 Introduction

This section will provide a configuration of the slow strain rate tensile (SSRT) testing machine and its compositions such as load frame, motor and reducing gearbox system. The design of both pulled rod with load cell and linear variable differential transformer are illustrated. The schematic diagram of tensile specimen will provide in this chapter. Finally, the developed chemical cell is shown in schematic diagram.

AI.2 Configuration of SSRT testing machine

Figure AI.1 through figure AI.5 shows the configurations of load frame, pulled rod and driven system.

AI.3 Schematic diagram of Tensile Specimen

Figure AI.6 shows the schematic diagram of tensile specimen.

AI.4 Schematic diagram of Developed Chemical Cell

Figure AI.7 shows the schematic diagram of developed chemical cell.



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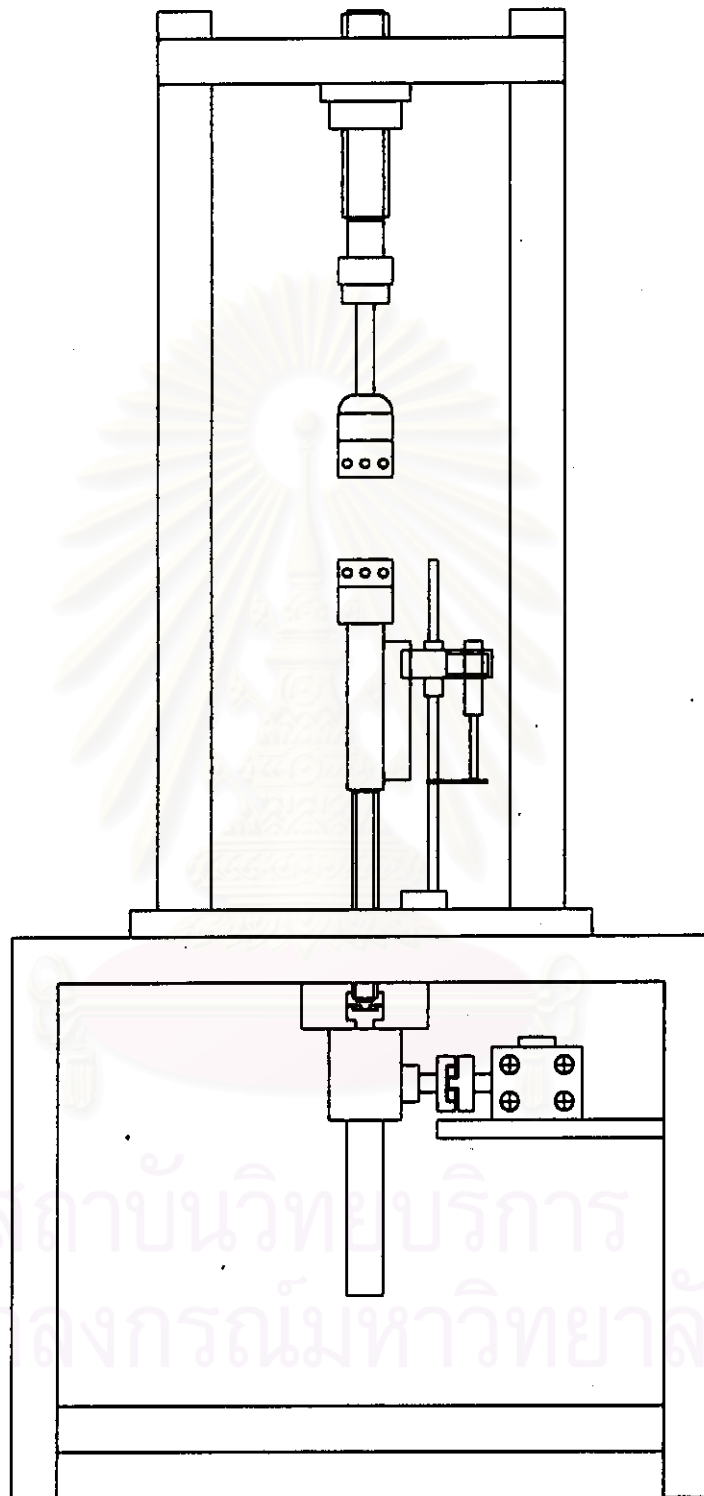


Figure AI.1 Schematic diagram of slow strain rate tensile unit.

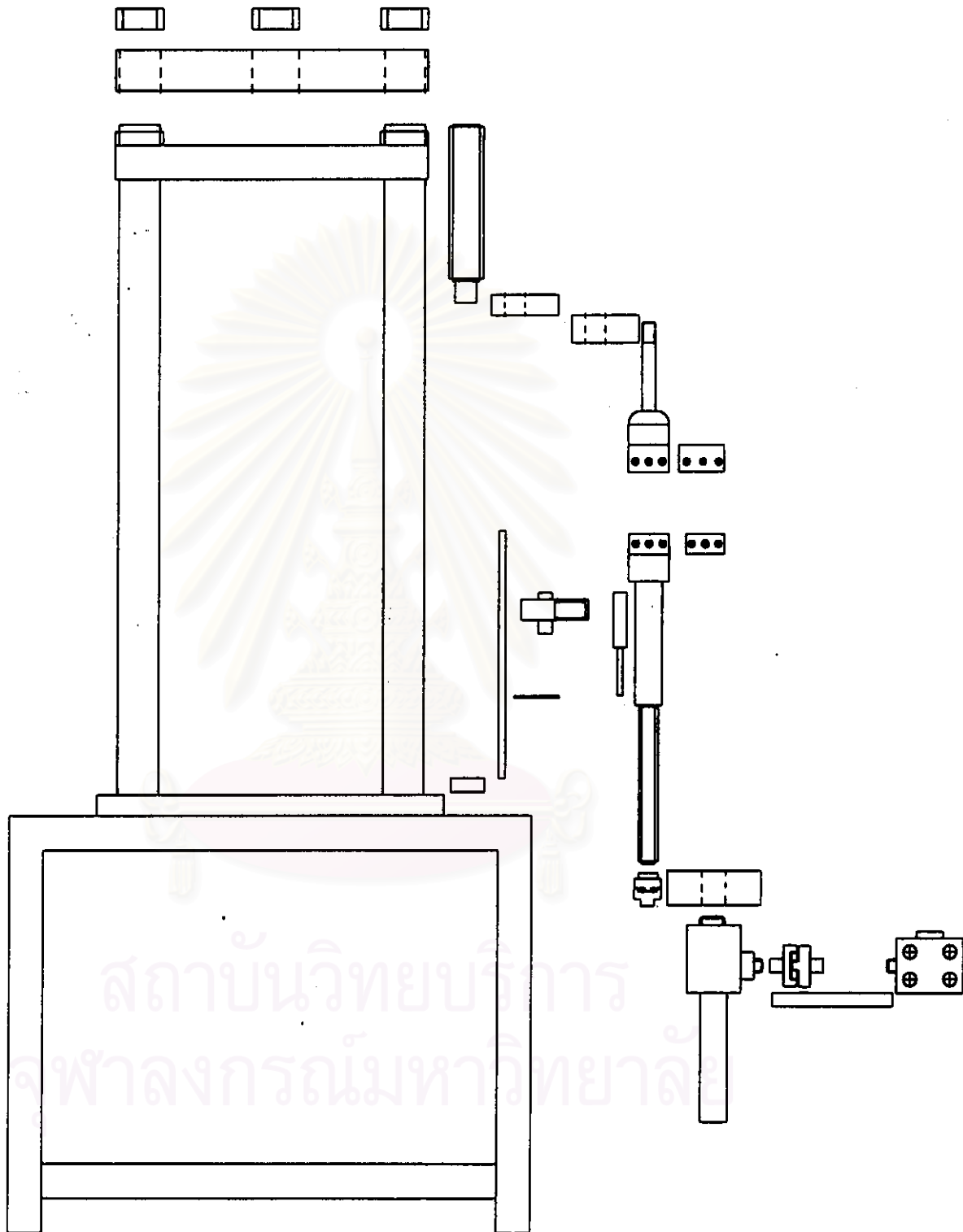


Figure AI.2 Illustration of the detail of SSRT unit.

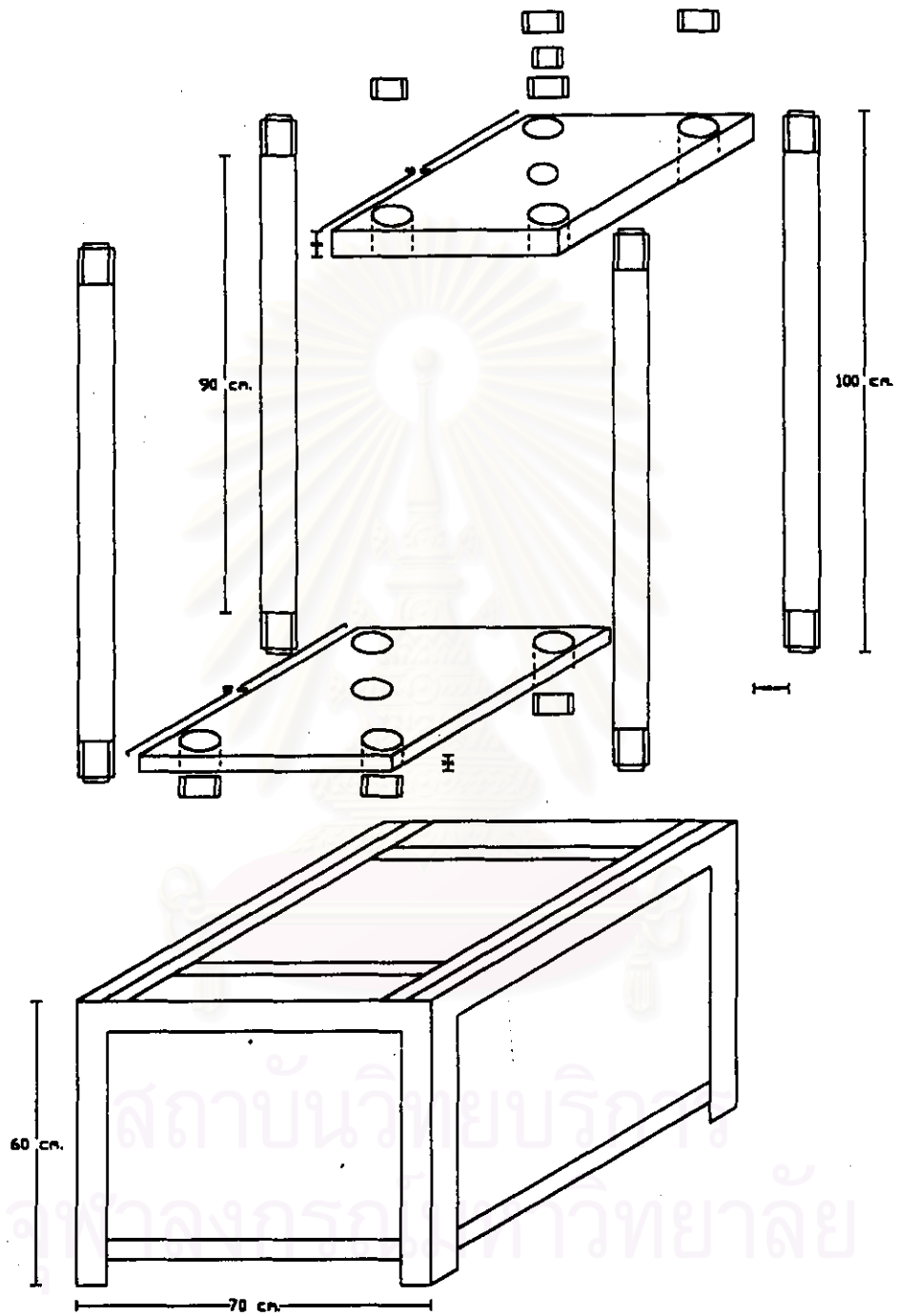


Figure AI.3 Schematic diagram of load frame.

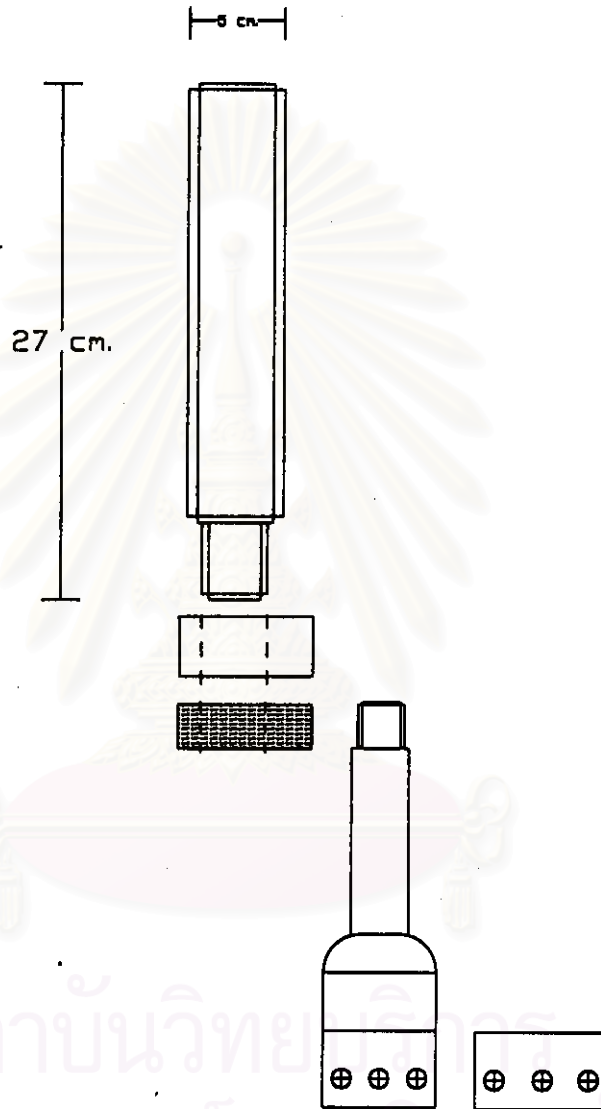


Figure AI.4 Schematic diagram of the upper load train.

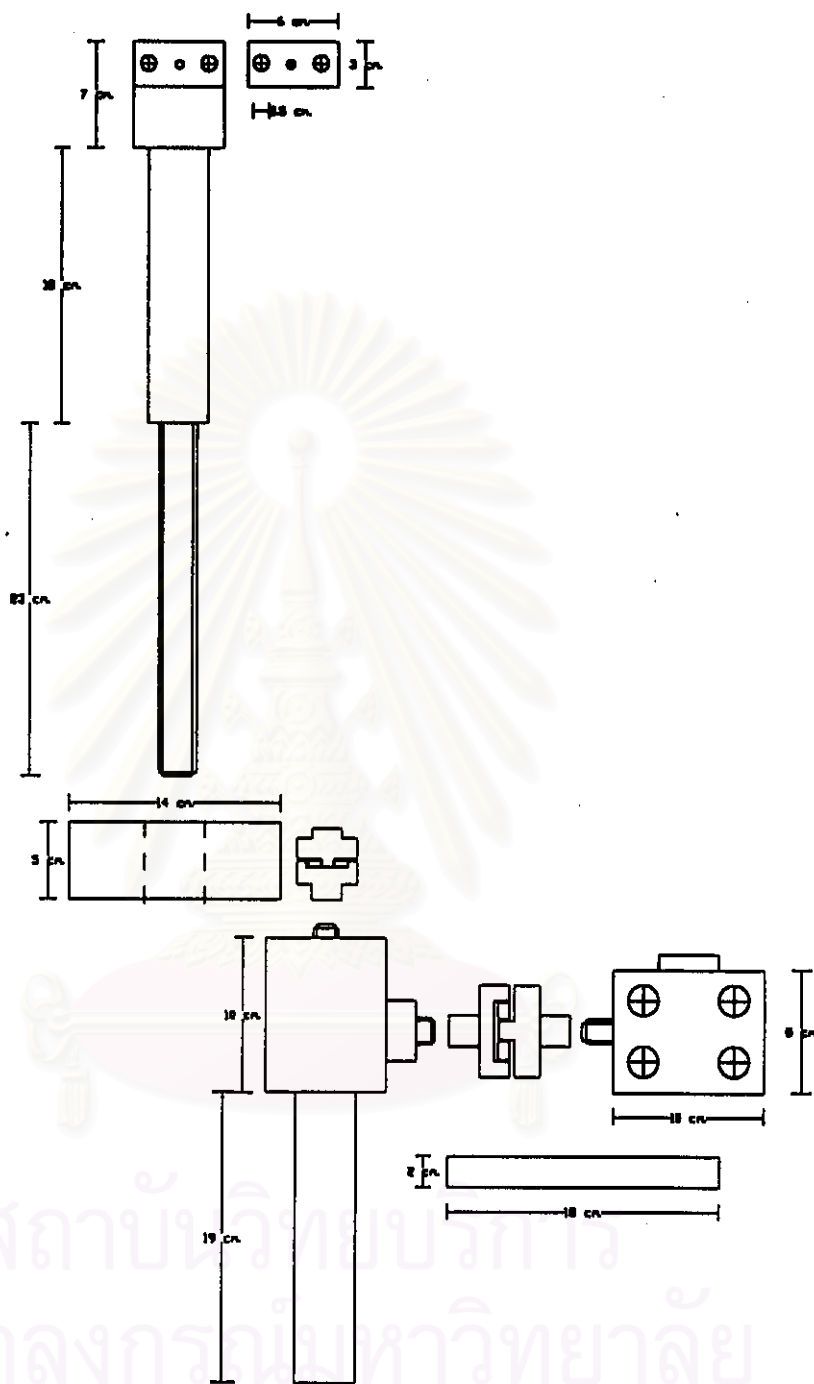


Figure AI.5 Schematic diagram of the lower load train.



Figure AI.6 Schematic diagram of tensile specimen used in this thesis.

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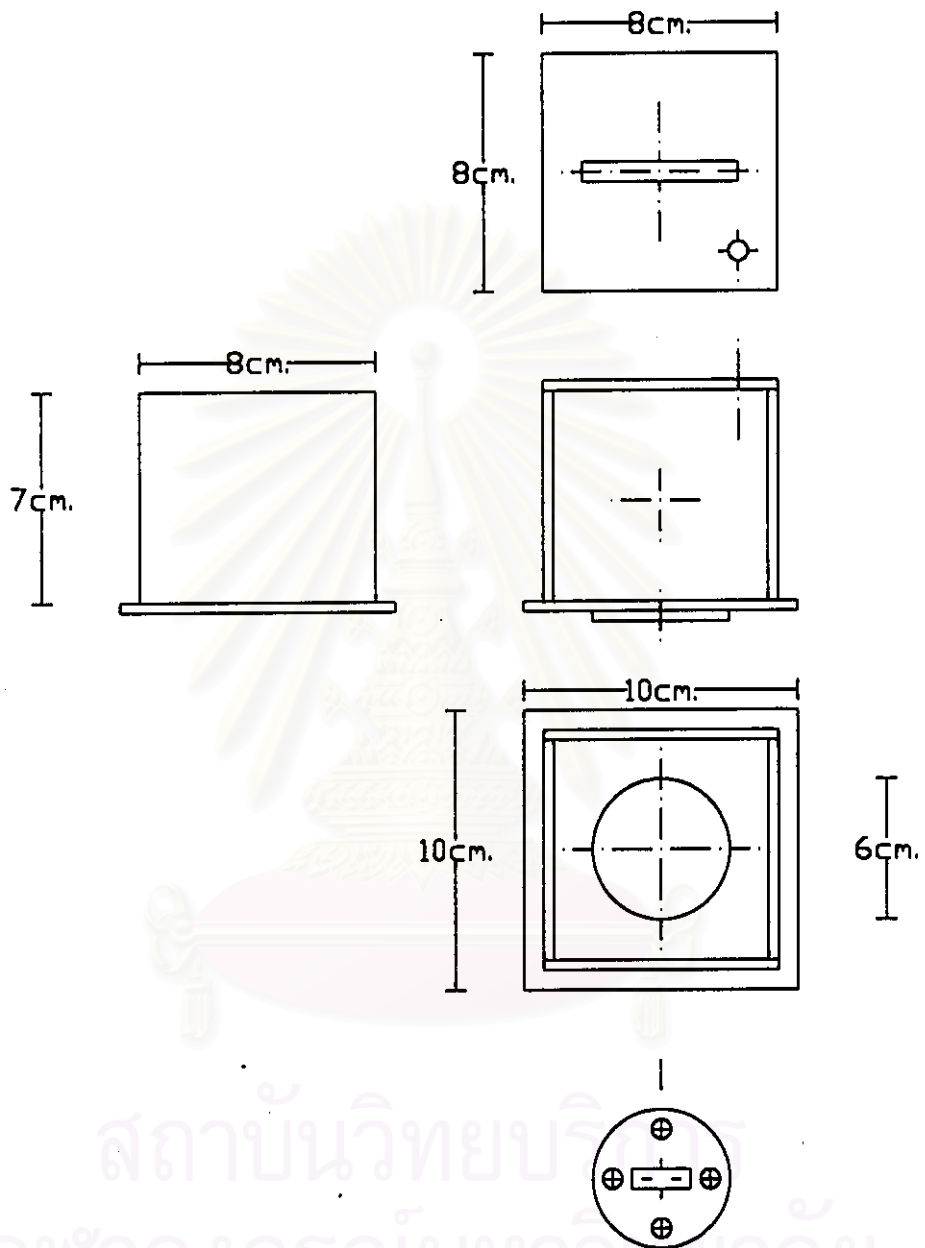


Figure AI.7 Schematic diagram of developed chemical cell.

Appendix II

COMPUTER PROGRAM FOR DBPA SPECTROSCOPY

AII.1 Background

The objective of this work is to develop the computer program for analyzing doppler broadened positron annihilation (DBPA) peak. It has become common practice to describe the annihilation line by a “line parameter”; S, introduced by MacKenzie et al. To evaluate the shape profile of an annihilation line reflecting the state of microstructure inherent in the solid. The statistics of the S parameter is of concerned because the percentage of S parameter is only in the order of a few percent as defects change. In evaluating the state of microstructure using DBPA spectroscopy, it was the 511 keV gamma line that will be affected by defects density and distribution.

The S parameter is defined as the ratio between the centroid area and the total peak area. The S parameter can be expressed as:

$$S = \frac{n}{N} \quad (4.1)$$

where n is the centroid area between $511 \pm \Delta\epsilon$ ($\Delta\epsilon$ is the energy shift depending on the materials being investigated) and N is the total peak area, figure AII.2. It should be noted that thus far there is no standard criterion for selecting the value of $\Delta\epsilon$ although a value of 1 keV has been cited in a few occasions. Nevertheless, the measurement system could be affected by many variables resulting in the instability of the peak shape affecting the accuracy in the S parameter. Hence, it is not trivial to calculate the S

parameter by simply fixing the ΔE value in equation (4.1) since the shape of the spectrum may not be constant in each measurement. To solve this problem, the 1274 keV gamma ray, which decay from Na^{22} , was proposed to use as the reference spectrum for each experimental variation. From the decay scheme of Na^{22} , figure AII.1, it was clearly seen that there is a direct correlation between each positron and 1274 keV gamma ray that given off from Na^{22} source. The 1274 keV spectrum is insensitive to the microstructures of the specimen while the 511 keV resulted from positron/electron annihilation within the specimen are significantly influenced by the microstructures of the specimen. As a result, the 1274 keV spectrum carries all the information about the system variations of each experiment and identical to that in the 511 keV spectrum except the state of the microstructure of the specimen. Thus it may be used to compensate for the system variations and directly compare the S parameter of varying states of microstructure. To correct the S parameter of the annihilation spectrum, it was proposed that the S parameter of the reference spectrum be fixed to be 0.5 in order to first extract information on the width of centroid energy, ΔE value. Since the ΔE value of the reference spectrum is only affected by system variation and not by microstructure, thus the ΔE value calculated from the 1274 keV spectrum can be used as a reference to evaluate the S parameter of the corresponding annihilation spectrum.

Based on the above-mentioned technique, the total area of the reference spectrum was first calculated and the centroid area to give the S parameter of 0.5 was determined. The calculated ΔE value was used to calculate the centroid area in the corresponding annihilation spectrum. A computer program was proposed to automatically extract the ΔE values of the references spectra with S parameter = 0.5 ± 0.00000001 and also used the calculated ΔE with the corresponding S parameter of the annihilations spectra.

AII.2 Using the ComPAS

AII.2.1 General Notes:

This part tells you how to use the Computer Program for Doppler Broadened Positron Annihilation Spectroscopy (ComPAS), and provides guidelines for updating the program. The ComPAS has been written for DOS. In your ComPAS directory, *type ComPAS*, this will run the program and you will come to the main menu of the ComPAS as shown in figure AII.3. The procedural instructions will be described later.

Please note; the data file to be analyzed must be in same directory as the program.

AII.2.2 Main Menu

The user operates ComPAS through a menu displaying on the screen. The menu options, which are available by pressing a single button, include

AII.2.2.1 Simulation of the Radiation Spectrum

This option has three modes of simulation of the spectrum. The first mode lets you simulate the spectrum by smoothing the observed count. It is the simple technique used to correct the distribution of the observed count in the spectrum.

The second mode simulates the summation curve by calculating the average of both energy and observed count in the spectrum. The summation curve used to sum up the series of spectrum obtained from experiments.

The last mode let you simulate the Gaussian curve. It lets you calculate the centroid energy (peak) and standard deviation of the spectrum that needed to simulate new Gaussian spectrum.

AII.2.2.2 Calculate the S parameter Using a Smooth Curve technique

This option is selected when you need to calculate the S parameter using the smooth curve technique. It lets you simulate the new spectrum by smoothing the observed count per energy. To create the new spectrum, the number of data point used to smooth the observed count and new filename to store the spectrum are need. The smoothed curve is a suitable form used to calculate the total peak area, the centroid area by using trapezoidal technique as described later.

Please noted; the various numbers of data points used to smooth the observed count give you the various shape of the spectrums.

AII.2.2.3 Calculate the S parameter by Fixing the Energy Shift

This option is selected when you need to calculated the S parameter of the spectrum by fixing the energy shift technique. It let you simulate the summation curve and then smooth the observed count to create the new spectrum used to calculate the total peak area, the centroid area and the S parameter of annihilation spectrum.

AII.2.2.4 Calculate the S parameter Using Fix S parameter technique

This option lets you calculate the S parameter using summation curve, smooth data and a fixed S parameter of reference spectrum. It lets you simulate the summation curve and then smooth the observed count to create the new spectrum used to calculate the total peak area, the centroid area, the energy shift and the S parameter of both spectra.

AII.2.2.5 Calculate the S parameter Using Gaussian Fit

This option is selected when you need to assume the spectrum presented in Gaussian distribution. It lets you simulate the summation curve and then smooth the observed count automatically. The next step is to calculate the centroid energy (peak) and standard deviation of the raw data. Moreover, to simulate new Gaussian spectrum, two parameters are needed as the correction factor and probability of the data. The centroid energy, standard deviation, correction factor and probability are necessary when assuming the spectrum presented in Gaussian distribution.

AII.2.2.6 Calculate the S parameter from Simulated Curve

This option lets you recalculated the S parameter of the spectrum, if you need to change either the value of S parameter of the reference spectrum or the energy shift that used to calculated the centroid area of the spectrum.

AII.2.2.7 Exit Program

This option used when you need to exit the program.

AII.3 Procedure Operation Features

AII.3.1 Procedure EditData;

This procedure is used for rearranging the data to suitable form for used in ComPAS. In this procedure you will enter the filename of the spectrum that you want to rearrange and a new one for rearranged data. Moreover, this options is used to correct the observed count by subtracting the background and calibrating the channel number to energy using equation (2a) as described later. Figure AII.4 illustrates the flow chart of this procedure.

AII.3.2 Summation Procedure;

The summation curve technique is selected to correct the different in shape of the spectrum in the series of experiment. To simulate the new spectrum, the program will calculate the average of energy and observed count per energy in the spectrum and then simulate the new curve. A typical operation for this procedure is as following:

1. Get the number of spectrum in the series of experiment used to simulate the summation curve.
2. Get the entire spectrum from the data file.
3. Calculate the average of energy and observed count.
4. Simulate the new spectrum and then write it to the data file.

A flow chart of this procedure is shown in figure AII.5.

AII.3.3 Smoothing Procedure;

This procedure used to smooth the observed count per energy in the spectrum to correct the error in shape of the spectrum. It is necessary for assuming the spectrum presented in Gaussian distribution and suitable form to calculate the total peak area, the centroid area, the energy shift and the S parameter. To smooth the observed count per energy, the number of data used to smooth curve and new filename to store the spectrum are needed. Figure AII.6 show the flow chart of this procedure.

AII.3.4 Procedure Centroid;

This procedure is used for calculating the centroid energy and standard deviation. It will automatically calculate the centroid energy and standard deviation after smoothing curve technique finished. The correction factor and probability of the data are calculated in the next step, and then the program will simulate the new Gaussian spectrum. Flow chart of this procedure is shown in figure AII.7.

Please note; to simulate the Gaussian spectrum, the number of the data point used to calculated the standard deviation of the raw data are needed.

AII.3.5 CalFixE Procedure;

This procedure is used for calculating the S parameter of an annihilation spectrum using fix energy shift technique. First the program asks you to enter the value of the energy shift. The program will automatically calculate the total peak area (N) by equation (7a) and (8a). The centroid area of the reference spectrum is calculated by

equation (10a), while fixing the value of energy shift. This procedure will be accomplished by calculating the total peak area, the centroid area and the S parameter of the annihilation spectrum. The step of this procedure can be summarized as shown in figure AII.8 and will be described below”

1. Get the value of the energy shift from keyboard.
2. Calculate the total peak area and the centroid area of the reference spectrum.
3. Calculate and the S parameter of the reference spectrum.
4. Calculate the total peak area, the centroid area and the S parameter of the annihilation spectrum.

AII.3.6 CalFixS Procedure;

This procedure lets you calculate the S parameter of the annihilation spectrum by fixing the S parameter of reference spectrum. First the program asks you to enter the value of the S parameter of the reference spectrum, as you need. The program will automatically calculate the total peak area (N) by equation (7a) and (8a). The centroid area of the reference spectrum are calculated by equation (4.1), while fixing the error of S parameter = ± 0.0000001 . The energy shift is calculated later. This procedure will be accomplished by calculating the total peak area, the centroid area and the S parameter of the annihilation spectrum using the energy shift obtained from the reference spectrum. The step of this procedure can be summarizes as follows:

1. Get the value of S parameter from keyboard.
2. Calculate the total peak area of the reference spectrum.
3. Fix the error of S parameter of the reference spectrum = ± 0.00000001 and then calculate the centroid area and the energy shift
4. Recalculate the value of S parameter of the reference spectrum
- 5 Calculate the total peak area of the annihilation spectrum

- 6 Calculate the centroid area of the annihilation spectrum using the energy shift that obtained before.
- 7 Calculate the S parameter of the annihilation spectrum

Figure AII.9 shows the flow chart of this procedure.

AII.4 Algorithm Used in Computation.

A background is first determined by locating the minimum observed count per channel number in the spectrum and the channel peak are found by searching for maximum observed count channel number. To increase the efficiency of the computation, the energy calibration peaks are needed. The calibration peaks are required to calibrate the channel number to energy. For doppler broadened positron annihilation (DBPA) spectroscopy a linear formula relating energy to centroid is sufficient. The energy calibration peaks are computed by the equation:

$$\text{Energy} = A + (B \times \text{Channel number}) \quad (1a)$$

where A and B are determined by interpolations of gamma ray energy to the centroid energy.

The centroid of peak (\bar{x}) as a function of energy versus collected counts can be expressed as:

$$\text{Centroid energy} = \text{Peak} = \bar{x} = \frac{\sum_i^z \text{Energy}[i] \text{Count}[i]}{\sum_i^z \text{Count}[i]} \quad (2a)$$

where Count[i] is the count in energy i

The standard deviation (SD) is computed as the first moment of energy versus collected counts by equation:

$$SD = \frac{\sum_i^z (\text{Energy}[i] - \text{Centroid})^2}{(n-1)} \quad (3a)$$

To create the new gaussian spectrum, two parameters are required. One is the probability of the data that can be expressed as.

$$P[i] = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(\text{Energy}[i] - \text{centroid})^2}{2\sigma^2}} \quad (4a)$$

The other is the parameter, H, which is used to calibrate the new observed count per each energy and providing the new spectrum presented in Gaussian distribution. The parameter H is defined as the ratio between the centroid count of the spectrum and probability of the centroid energy. The parameter H can be expressed as:

$$H = \frac{\text{Centroid count}}{P[p]} \quad (5a)$$

and the new gaussian count can be calculated by equation:

$$\text{NewCount}[i] = P[i] \times H \quad (6a)$$

The centroid, standard deviation and the correction factor are necessary for creating the new spectrum presented in Gaussian distribution and to help reducing the computation time and error associated with ΔE value extracted from the reference spectra.

Peak areas are determined as the sum of area per energy at full width at tenth maximum (FWTM) that calculated by a trapezoidal technique. To calculate the S parameter of the annihilation spectrum by compensating technique, the total areas of reference peaks are calculated first. The total areas are calculated by equation:

$$\begin{aligned} \text{Area}[i] = & (0.5 \times \text{Abs}(\text{Energy}[i]-\text{Energy}[i-1]) \times (\text{Count}[i]-\text{Count}[i-1])) \\ & + \text{Abs}(\text{Energy}[i]-\text{Energy}[i-1]) \times (\text{Count}[i]-\text{Count}[i-1]) \end{aligned} \quad (7a)$$

$$\text{and} \quad \text{Total Area (N)} = \sum_i^z \text{Area}[i] \quad (8a)$$

If you assume the data present in Gaussian distribution, thus it is acceptable to calculate the total peak area from one side of the spectrum. The total peak area can be calculated by

$$\text{Total Area (N)} = 2 \times \sum_i^x \text{Area}[i] \quad (9a)$$

where i is the starting energy, x is the centroid energy, and z is the end energy. The total peak areas of both reference and annihilation spectrums are calculated by these equations.

Centroid area (n) of reference spectrum is computed by equation (4.1), while fixing the error of the S parameter to be 0.00000001. So, the centroid area must fall in the interval 0.49999999 N to 0.50000001 N . The $\Delta\epsilon$ value of reference spectrum is calculated in the next step. The calculation of $\Delta\epsilon$ can be summarized as follows:

1. Assume $\text{Energy}[x]$ and $\text{Count}[x]$ is the centroid energy and centroid count.
2. Calculate the area between $\text{Energy}[x]$ and $\text{Energy}[x-1]$ by equation:

$$\begin{aligned} \text{Centroid area} = & 2 \times \{ [0.5 \times (\text{Energy}[x-i]-\text{Energy}[x-1]) \times (\text{Count}[p-x]-\text{Count}[p-y])] \\ & + [(\text{Energy}[p-x]-\text{Energy}[p-y]) \times \text{Count}[p-y]] \} \end{aligned} \quad (10a)$$

while $x=0$ and $y=1$

3. Determine the calculated centroid area in previous step.

3.1 If the calculated centroid area is less than the acceptance centroid area, recalculate the area by vary $x = x-1$ and $y = y-1$. The calculated centroid area is the sum of them. Repeat this step until the calculated centroid area is greater than the acceptance centroid area. Note the value of x and y .

3.2 If the calculated centroid area falls in the interval of the acceptance area, the $\Delta\varepsilon$ value is the different of Energy[p] and Energy[p-y].

4. Assume $E_l = \text{Energy}[p-x]$, $E_r = \text{Energy}[p-y]$ and $\text{Energy}_A = \frac{E_l + E_r}{2}$, used

them instead of $\text{Energy}[p-x]$ and $\text{Energy}[p-y]$ in equation (10a), calculate the area between E_l and Energy_A . The calculated centroid area is the area between $\text{Energy}[p]$ and Energy_A .

5. From previous step, determine the calculated centroid area as following:

5.1 If the calculated centroid area is still greater than the acceptance centroid area, repeat $E_a = \frac{E_l + E_a}{2}$ and recalculate step 4 until the calculated centroid area is less than or fall in the interval of the acceptance centroid area.

5.2 If the calculated area is less than the acceptance centroid area, repeat $E_a = \frac{E_a + E_r}{2}$ and recalculate in step 4 until the calculated centroid area is greater than or fall in the interval of the acceptance centroid area.

Repeat these step until the calculated centroid area fall in the interval of the acceptance centroid area. The $\Delta\varepsilon$ is the different of Energy[x] and EnergyA

Centroid area of annihilation spectrum is the area between centroid $\pm \Delta\varepsilon$ by equation (10a). The S parameter is defined as the ratio between the centroid areas and the total peak areas. The S parameter can be expressed as written in equation (4.1).

List of Symbol

S	= the S parameter
n	= the centroid area
N	= the total peak area
$\Delta\varepsilon$	= the energy shift
Energy[i]	= array of energy used as program code
Ch	= channel number
Channel[i]	= array of energy number used as program code
A, B	= constant, determined by interpolation used for calibrating the energy peak
Peak, \bar{x}	= centroid energy of the spectrum
C1..C8	= observed count either per energy or per channel number
Count[i]	= array of observed count either per energy or channel number used as program code
z	= number of data in the spectrum
i, x	= index of data in the spectrum
Area	= the area under curve
Area[i]	= array of the area under curve used as programming code
Total	= total peak area under curve
Centroid	= the calculated centroid area used as program code
EnergyA, EnergyB	= energy shift used as program code

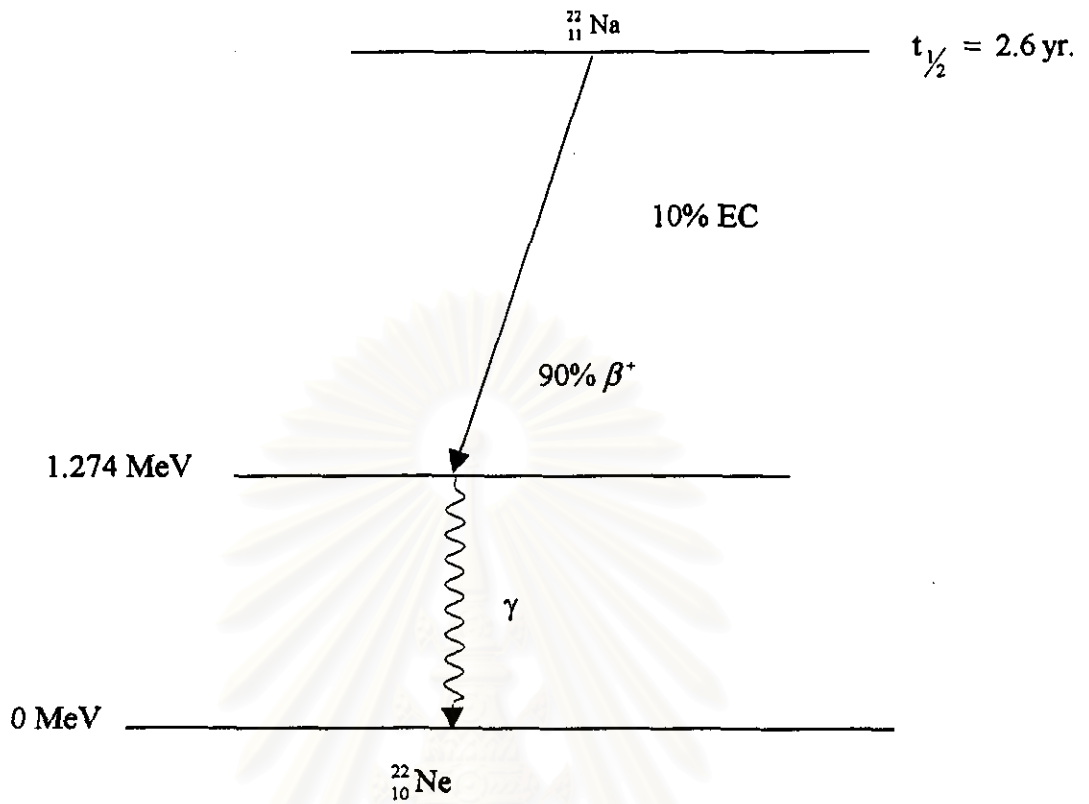


Figure AII.1 Shows the decay scheme of Na^{22} positron source.

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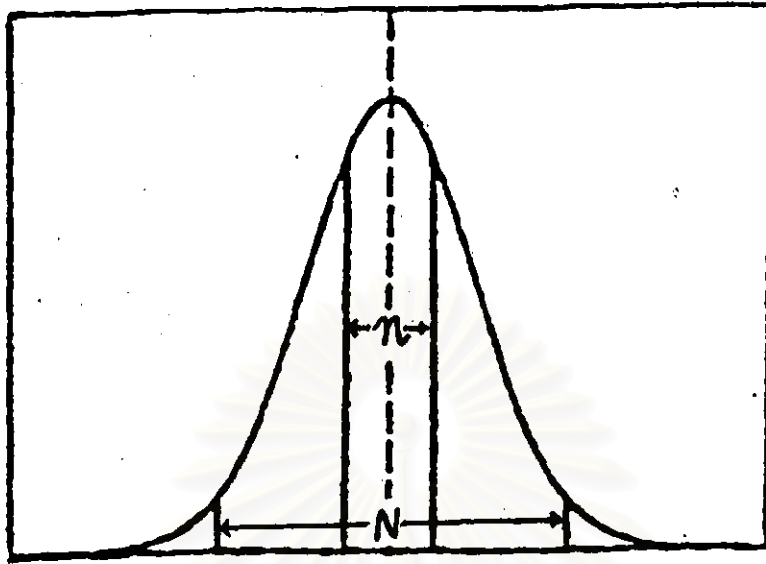


Figure AII.2 The definition of centroid area and total peak area used for calculate the S parameter.

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Computer Program for DRPA Spectroscopy
Developed by Ballomat Talerngsak

Main Menu
1...Simulation of the Radiation Spectrum
2...Calculate S parameter using a Smooth Curve Technique
3...Calculate S parameter by Fixing Energy Shift
4...Calculate S parameter using Fix S parameter Technique
5...Calculate S parameter using Gaussian Fit Technique
6...Calculate S parameter from Simulated Curve
7...Exit

Please Select (1-7) : _

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Figure AII.3 Illustration of the main menu of computer program.

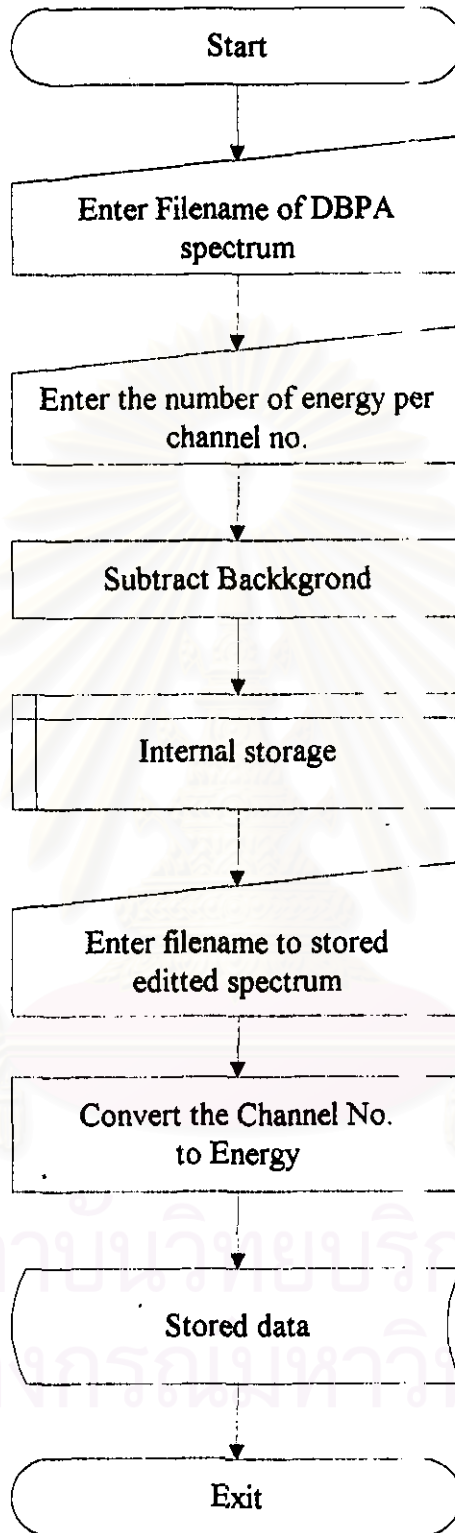


Figure AII.4 Flow chart of the EditData procedure.

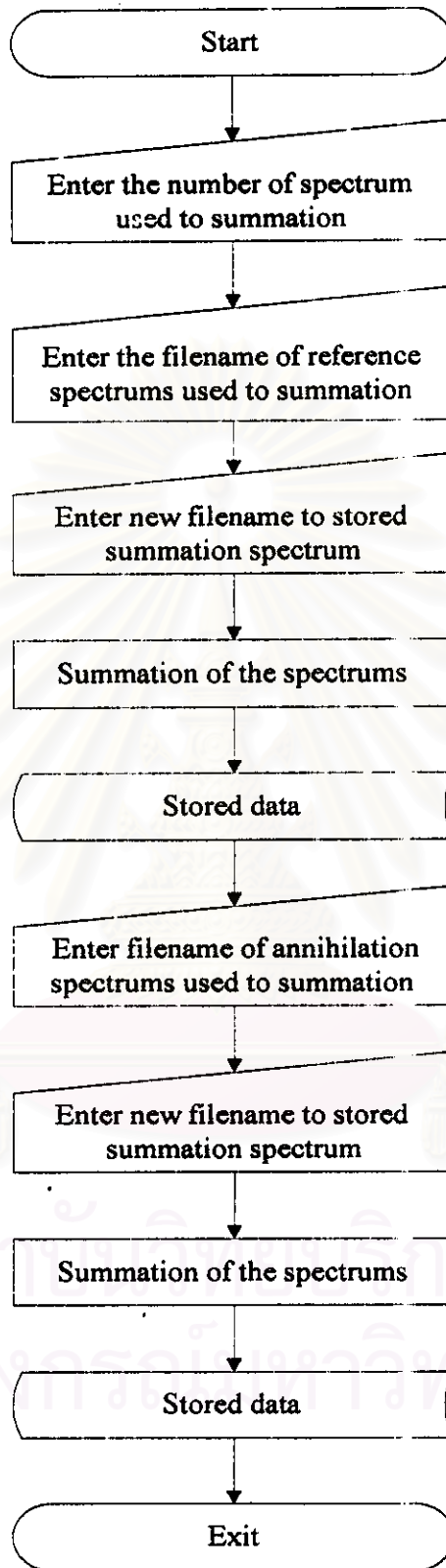


Figure AII.5 Flow chart of the Summation procedure.

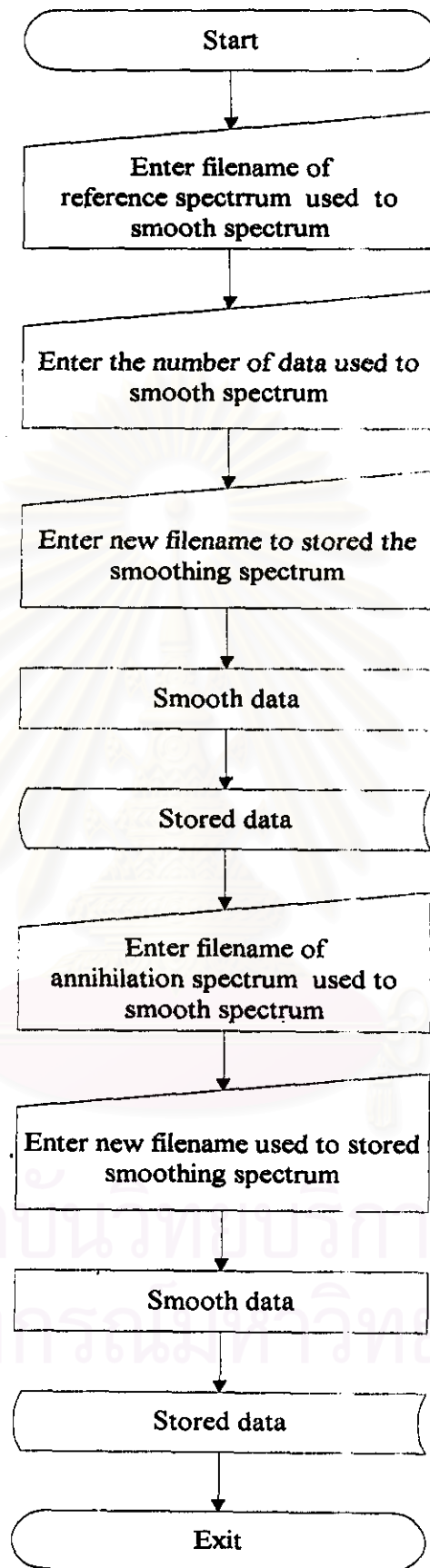


Figure AII.6 Flow chart of the Smoothing procedure.

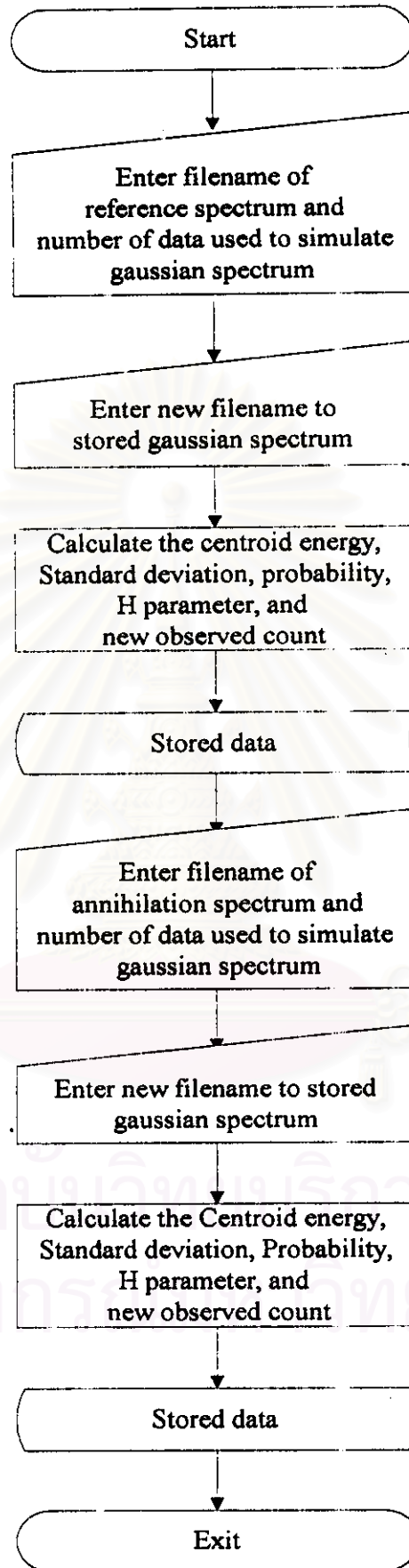


Figure AII.7 Flow chart of the Centroidal procedure.

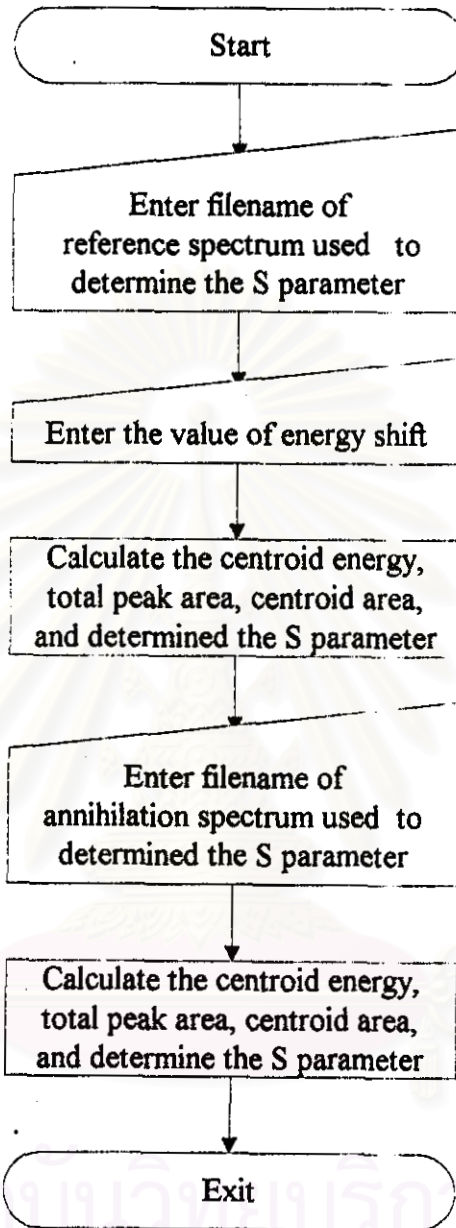


Figure AII.8 Flow chart of the CalFixE procedure.

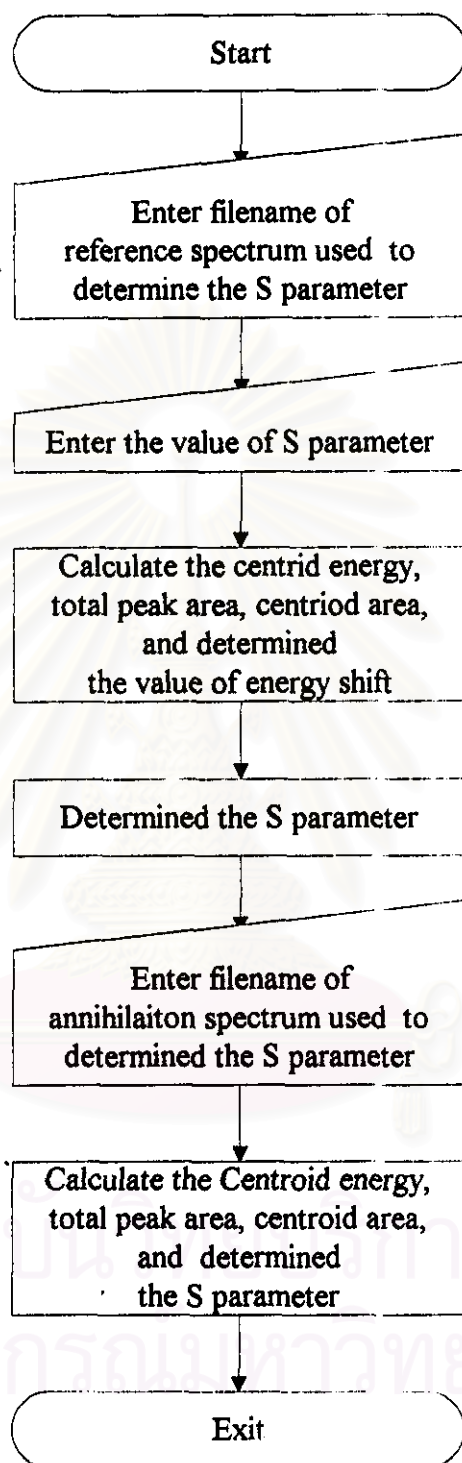


Figure AII.9 Flow chart of CalFixS procedure.

Biography

Kullawat Talerngsuk was born in Bangkok Thailand on June 15th, 1973. I am a student of the Mahidol University, from which I received a bachelor's degree in Science (Radiation Technology) in 1995. At the present, I am a graduate student of the department of Nuclear Technology of the faculty of Engineering of Chulalongkorn University (since 1995).



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