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APPENDIX

Measurements of Mechanicals Properties of Epoxy Polymer

Tensile Testing (ASTM D638)

Tensile testing was performed by used of Instron Model 4301. The cross head speed of Instron tensile testing at 500 mm./min. was used. The median of five specimens was take as the characteristic of the material tested. The load at rupture was record and divided by the original area of cross-section to express tensile strength in N/mm^2 using the following equation.

$$\text{Tensile strength} = F/A$$

F = Tensile force (N)

A = Cross-section area (mm^2)

The elongation at break or the ultimate elongation is the maximum extension of the specimen at the point of rupture.

$$\text{Elongation at break (\%)} = [(L-L_0)/L_0] \times 100$$

Where $L-L_0$ = Change of length

L_0 = Original length

L = Final length at the point of rupture

The plot of stress against strain yields the modulus of elasticity. This is the initial, straight-line portion of the stress-strain curve.

Stress-strain curves can also provide information on toughness of a material. An integration of the area under stress-strain curve is proportional to the energy-to-break per unit volume, which is a measure of the toughness of the specimen under the conditions of the test.

Specimen of epoxy polymer for tensile testing are produced by molding in dumbbell shape.

Thickness was then measured by a thickness micrometer. Three measurements of thickness were taken and the median value was used for calculating the cross-section area. Width of specimen is considered to be the width of the die used.

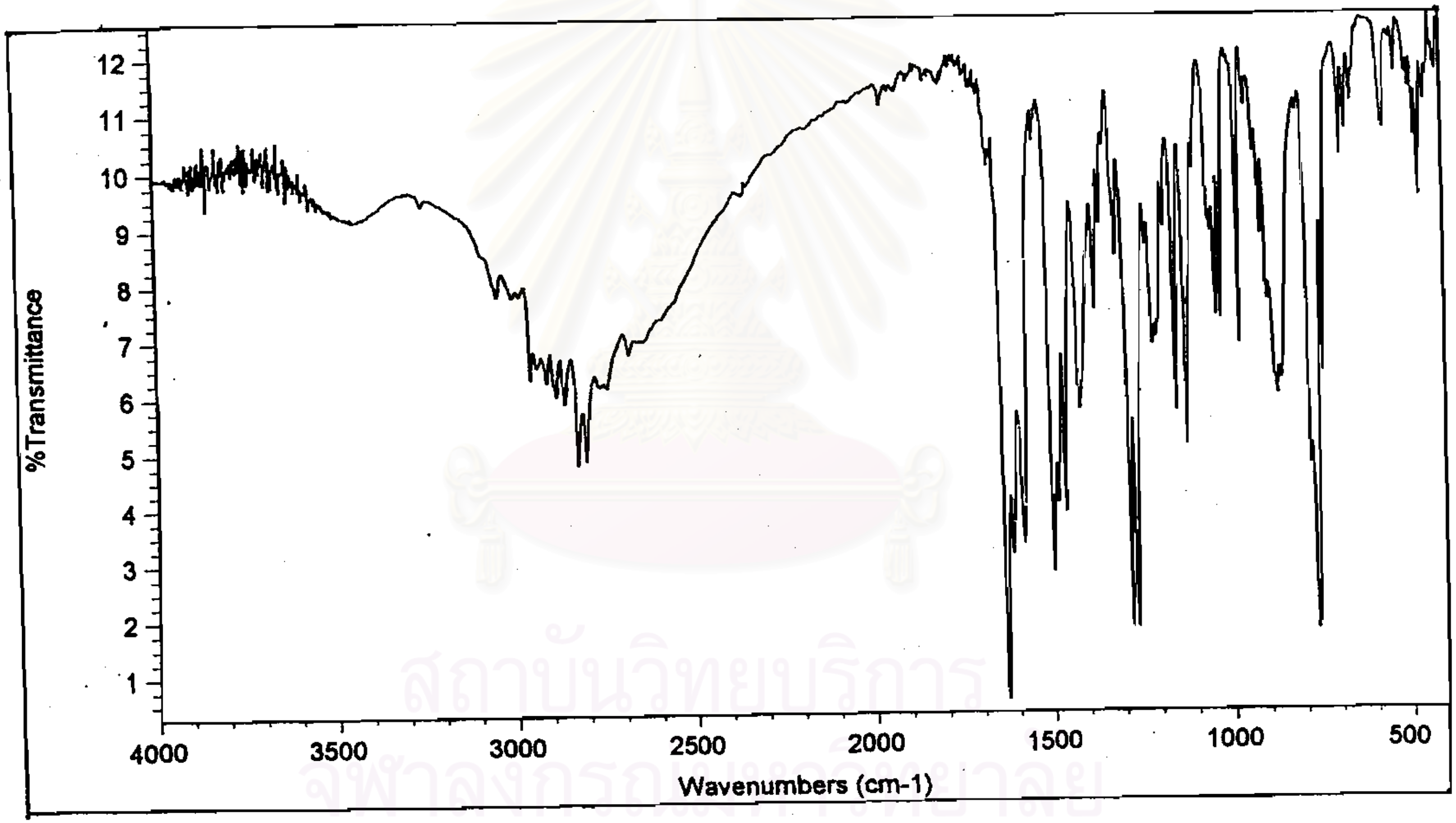

Figure A. 1 IR spectrum of Ligand (L)

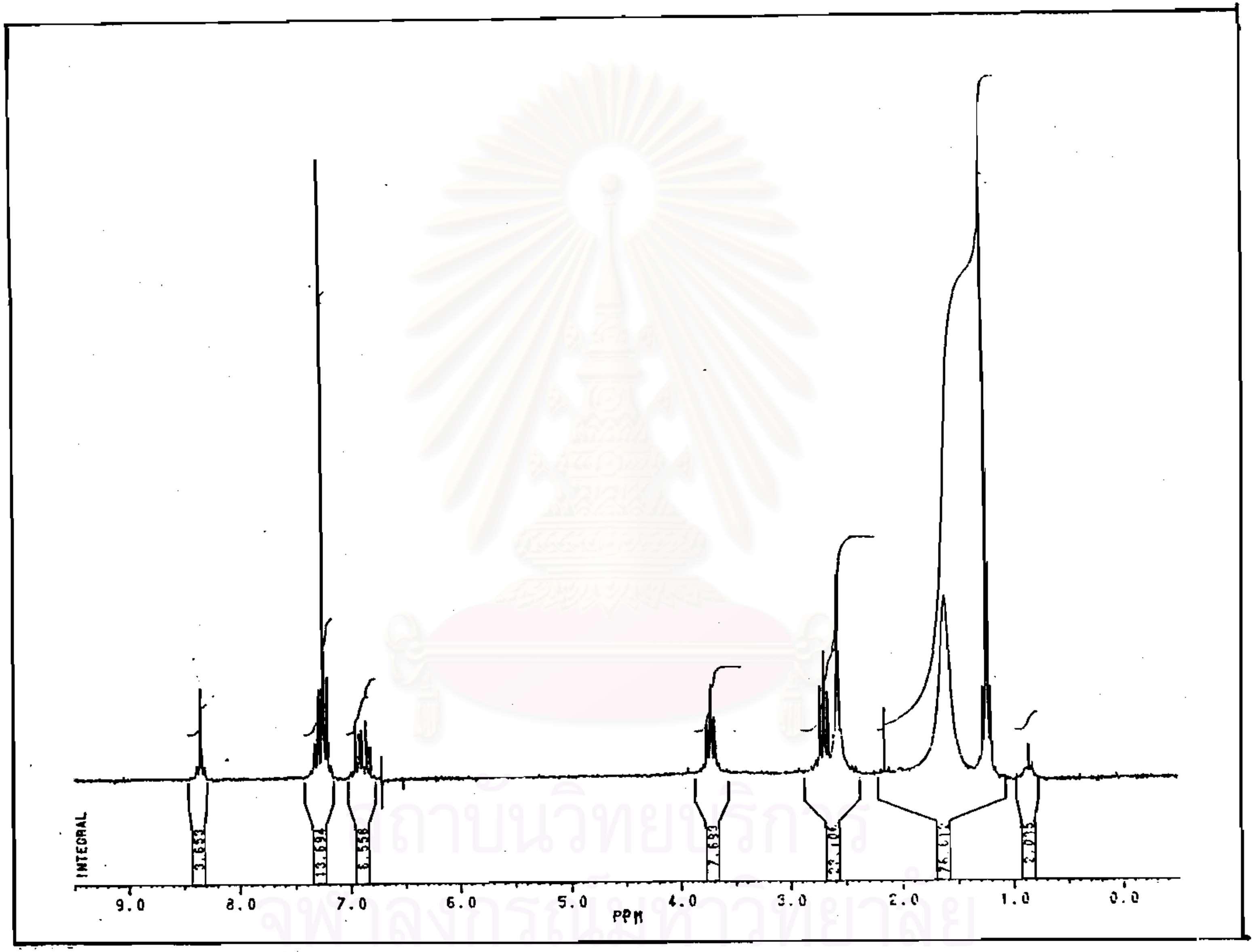

Figure A. 2 ^{1}H NMR spectrum of Ligand (**L**)

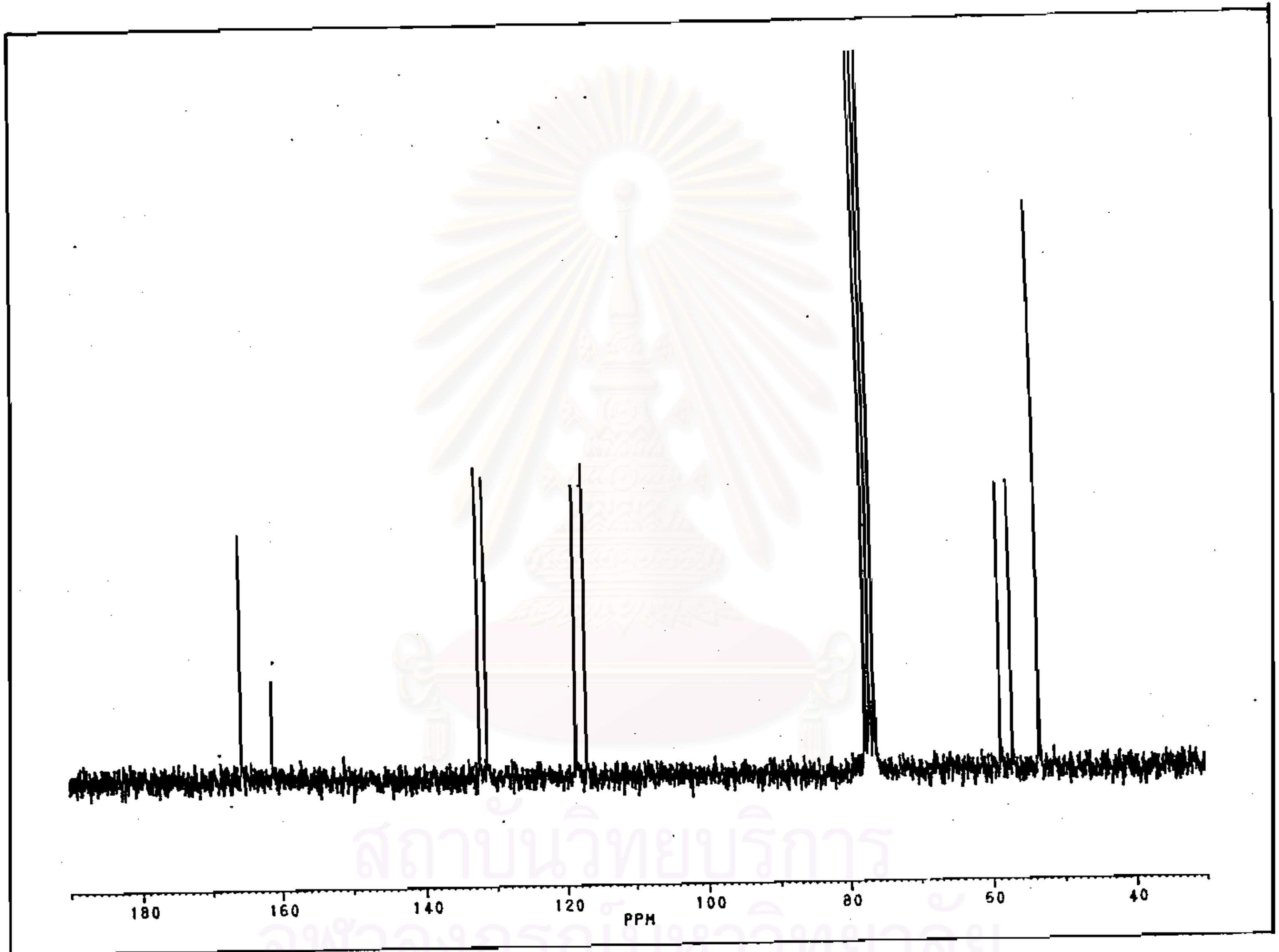

Figure A. 3 ^{13}C NMR spectrum of Ligand (L)

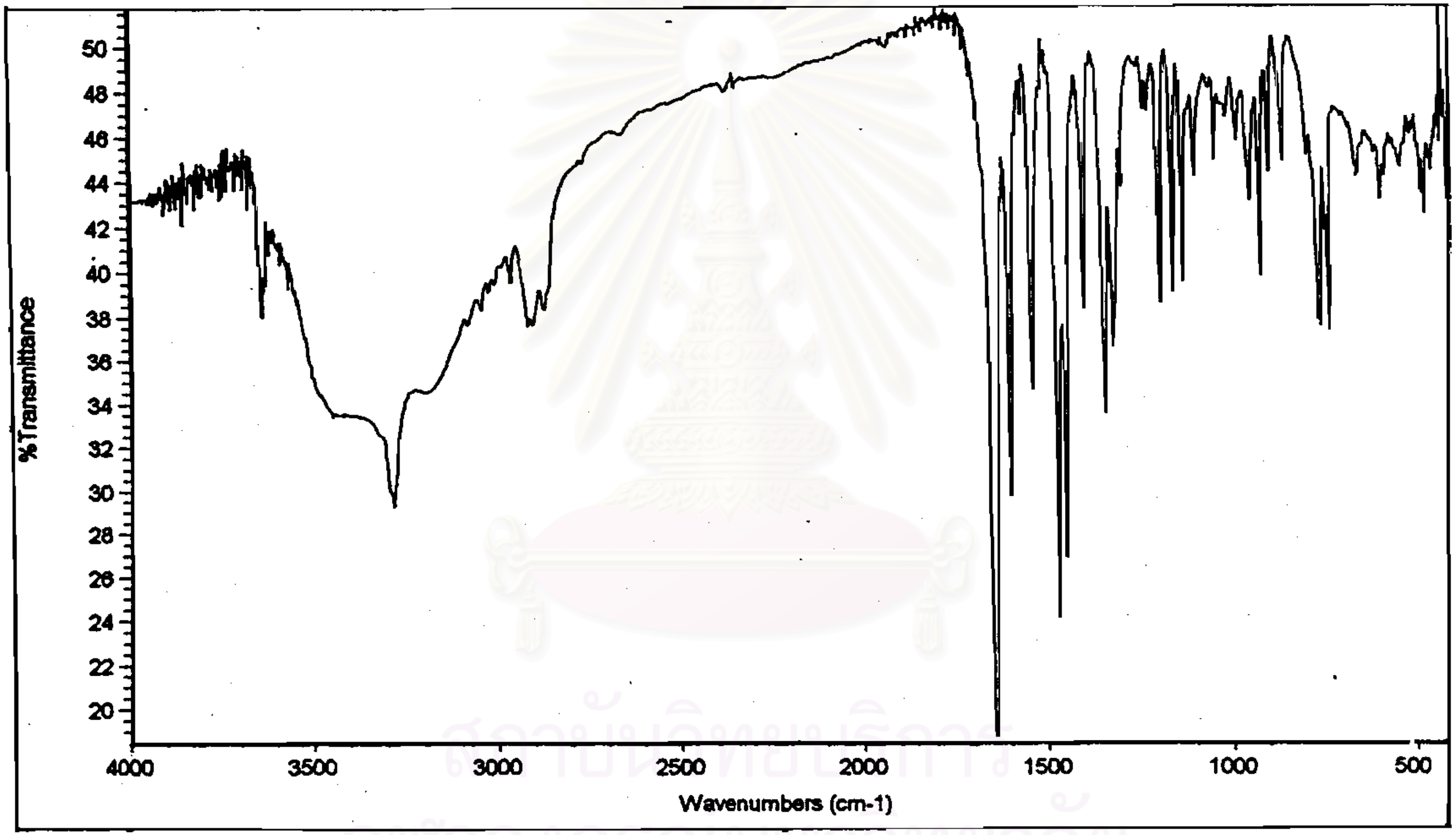

Figure A. 4 IR spectrum of NiL

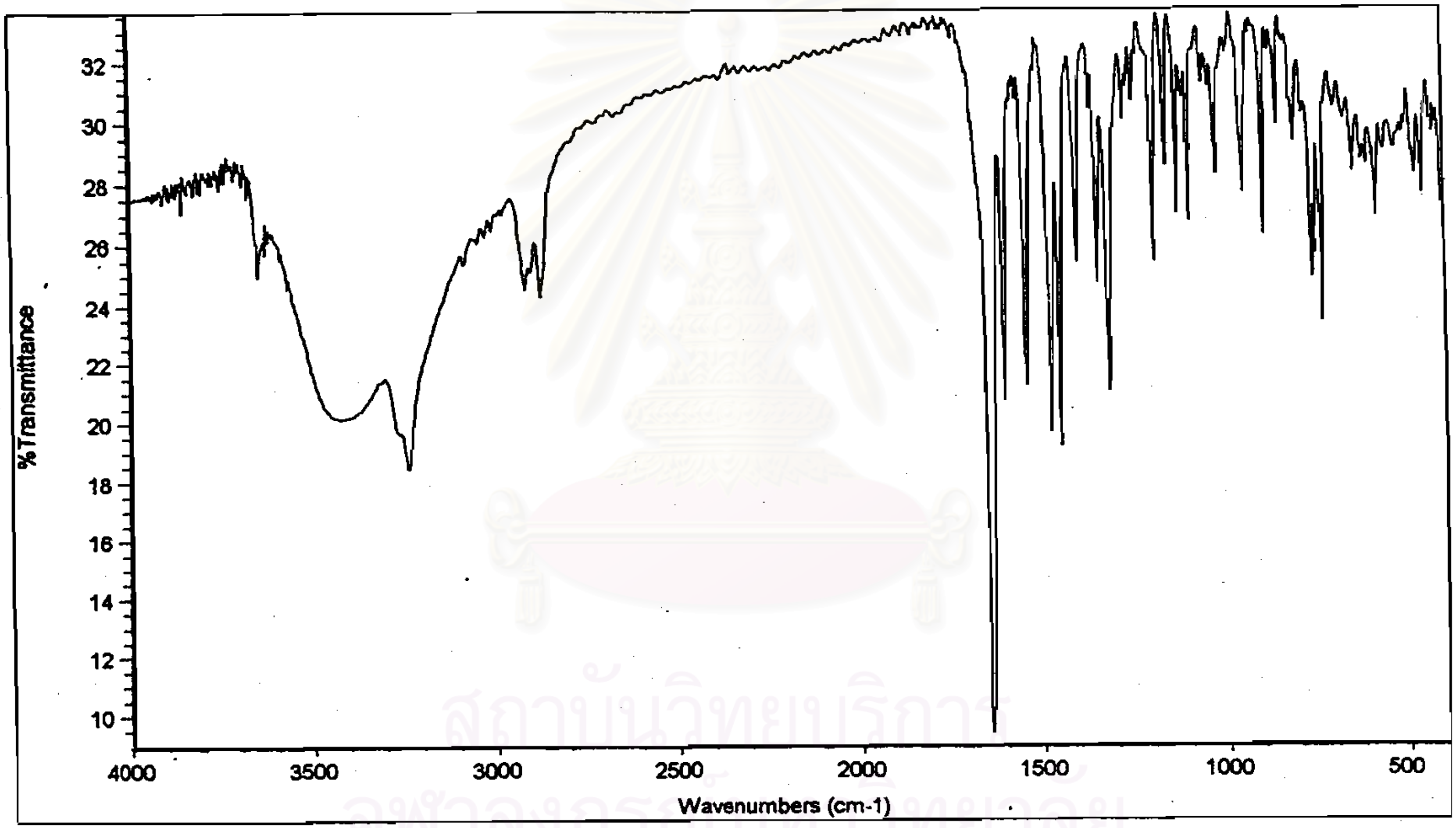

Figure A. 5 IR spectrum of ZnL

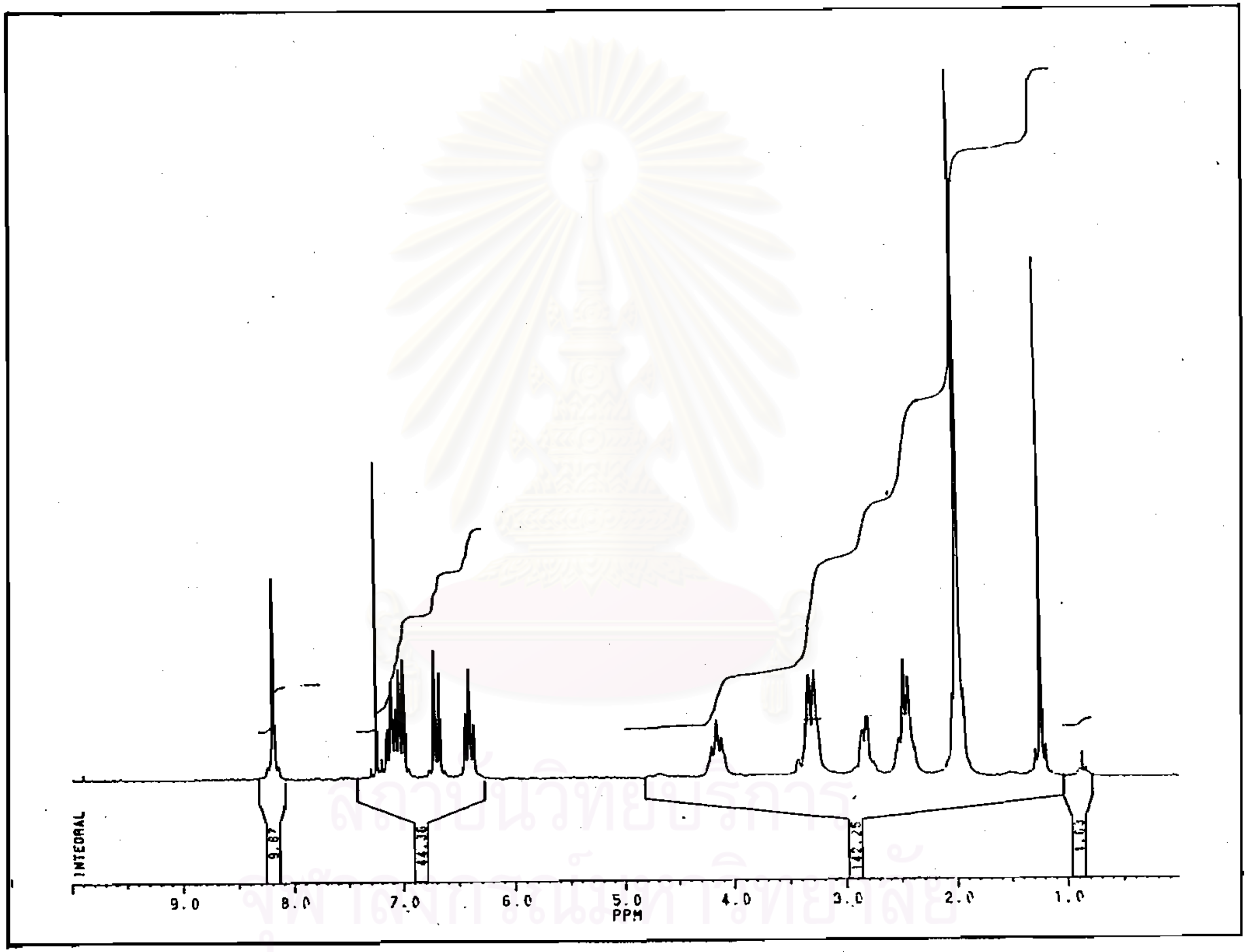

Figure A. 6 ^{1}H NMR spectrum of **ZnL**

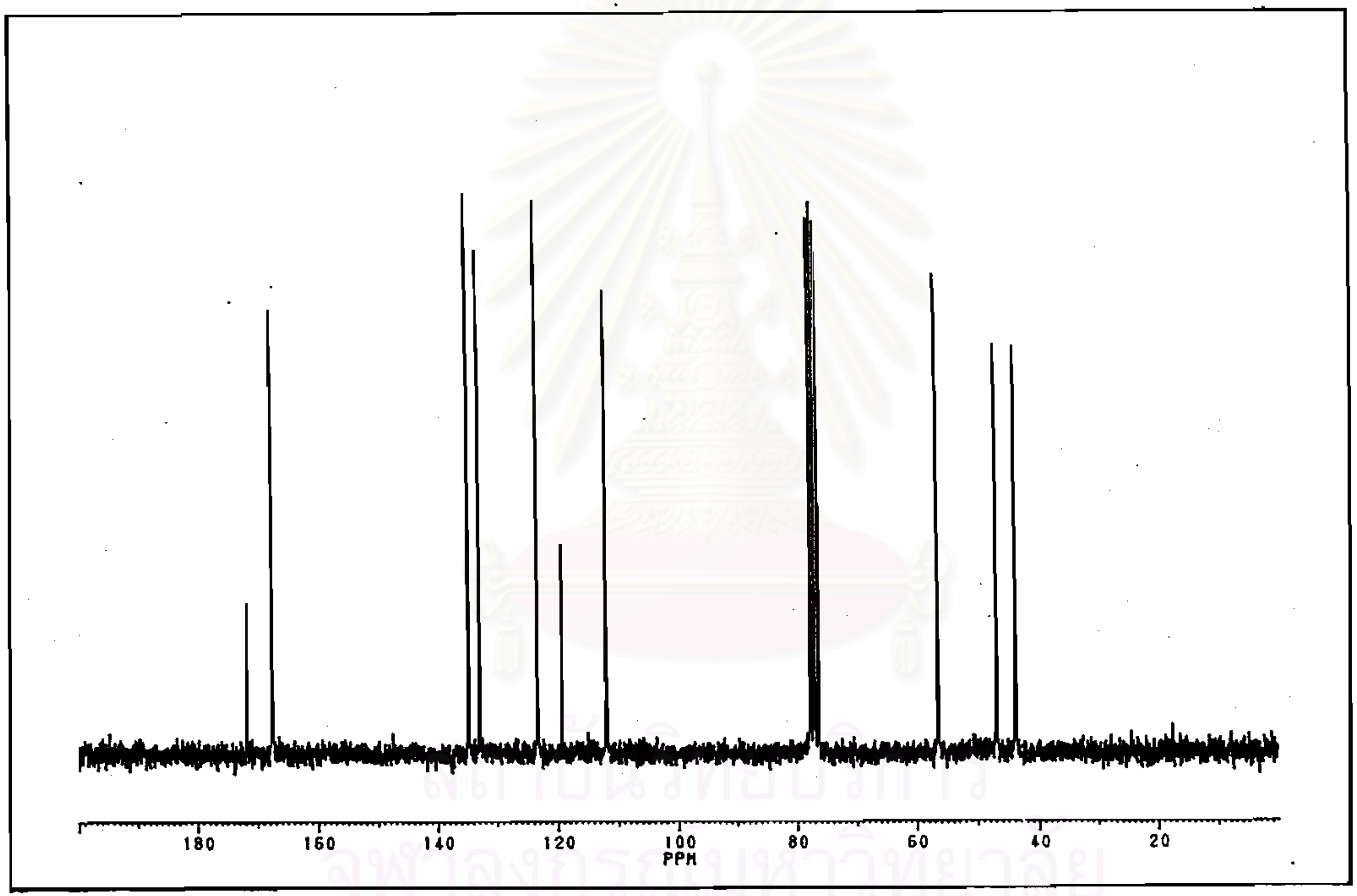

Figure A. 7 ^{13}C NMR spectrum of **ZnL**

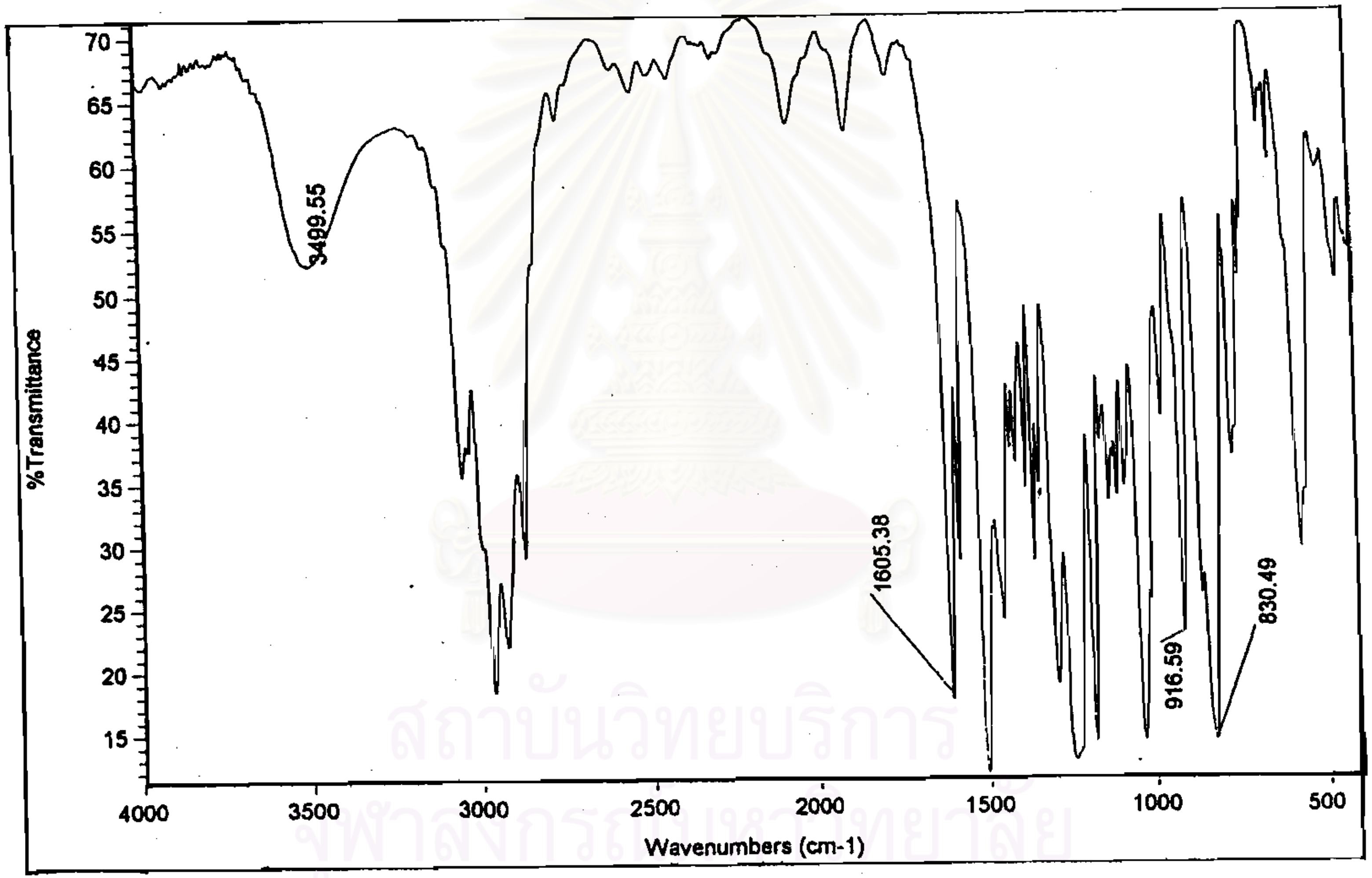

Figure A. 8 IR spectrum of DGEBA

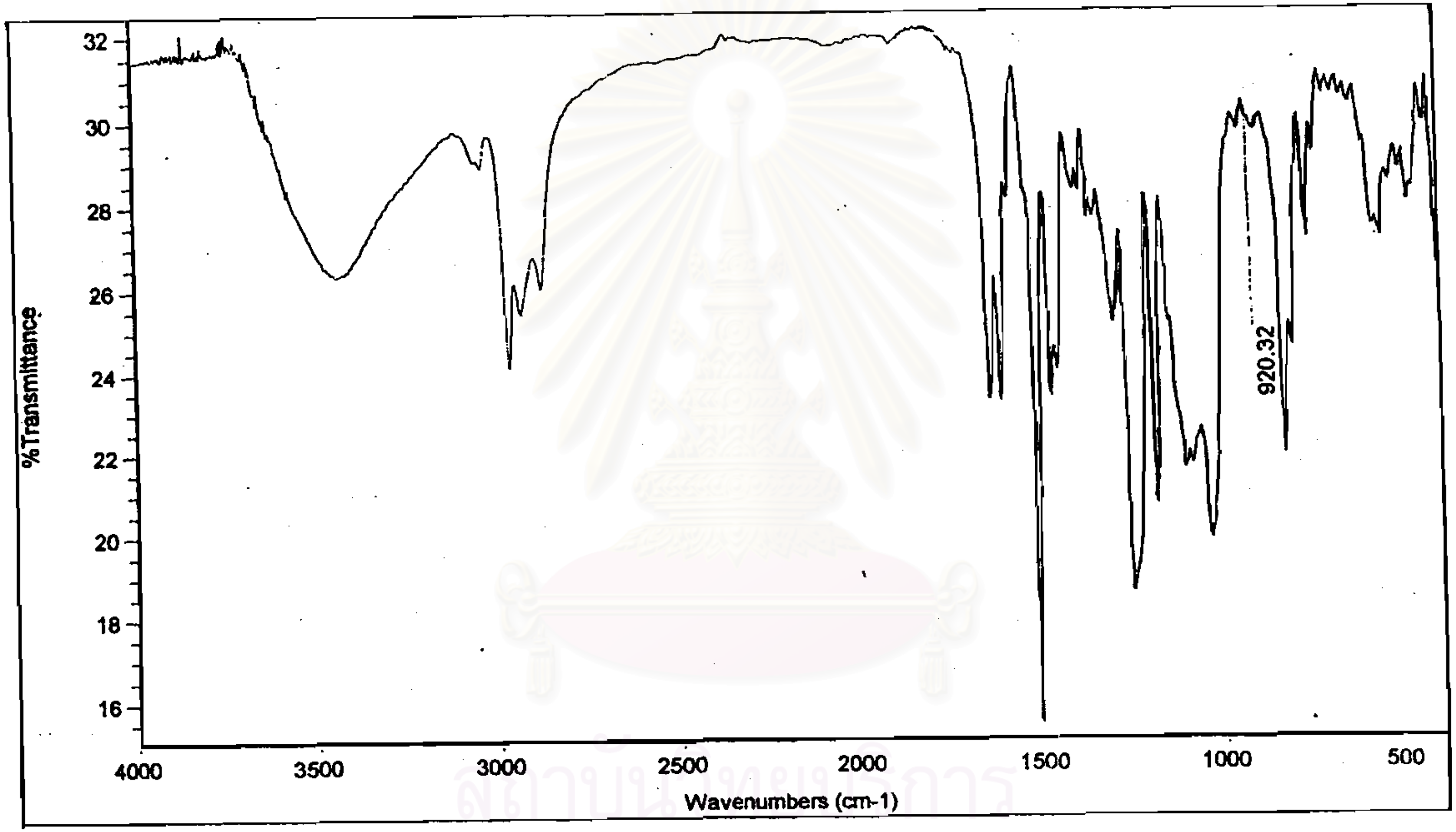

Figure A. 9 IR spectrum of Ni-containing epoxy polymer of NiL : DGEBA

at the equivalent weight ratio of 1:6

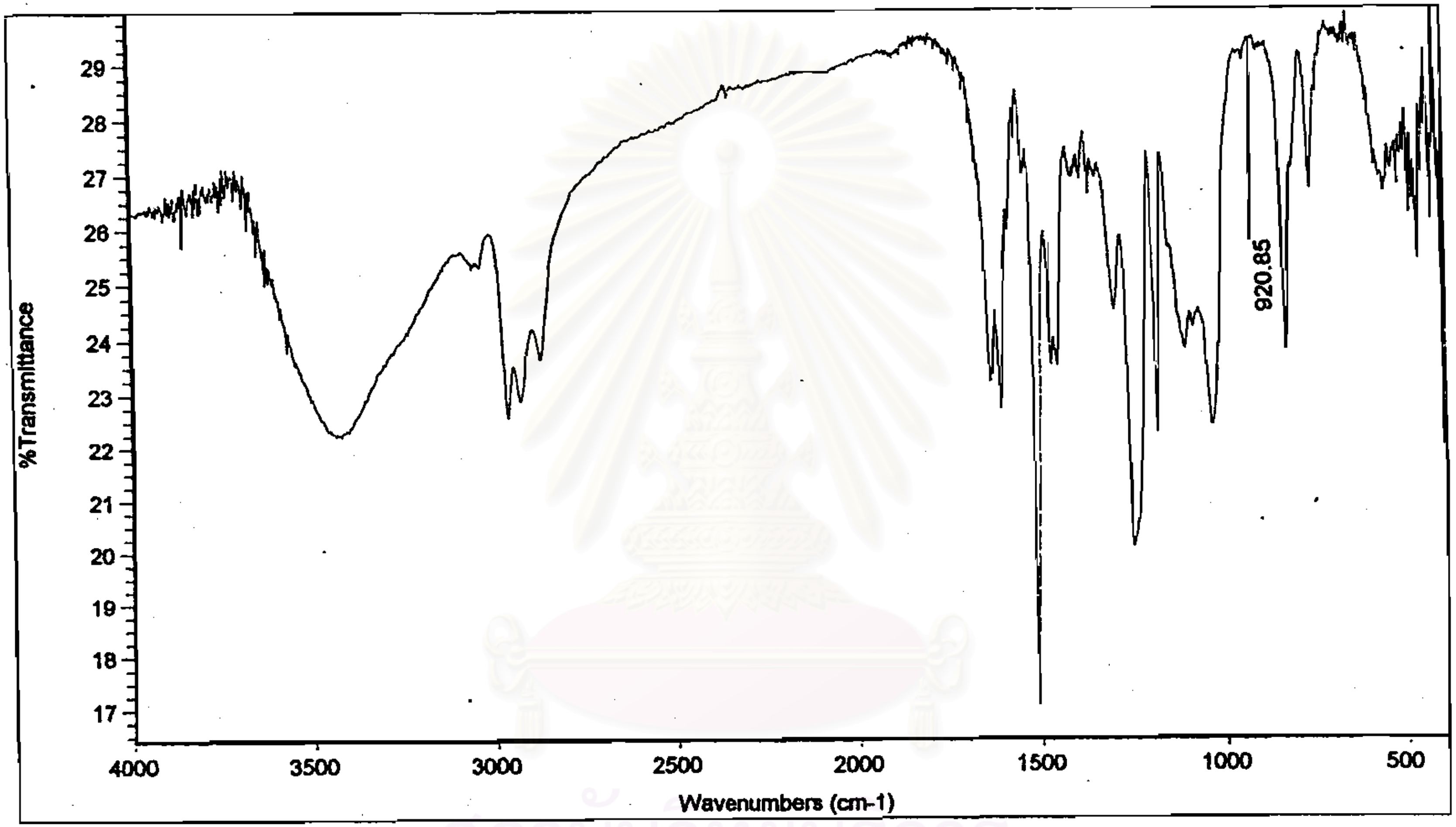

Figure A. 10 IR spectrum of Zn-containing epoxy polymer of **ZnL** : DGEBA at the equivalent weight ratio of 1:6

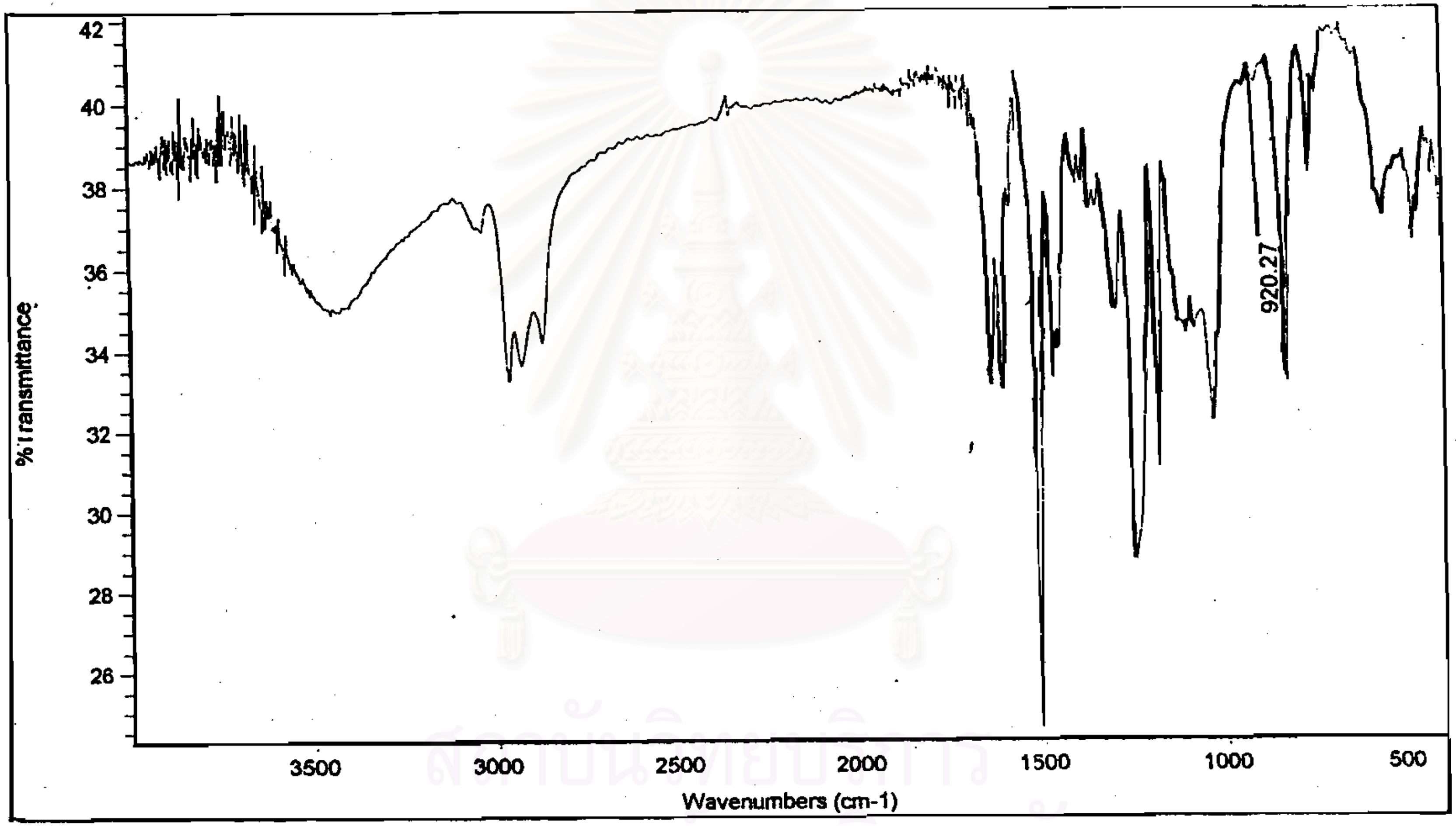

Figure A. 11 IR spectrum of Ni-containing epoxy polymer of NiL:DGEBA:Bu_4NOH at the equivalent weight ratio of 1:6:0.2

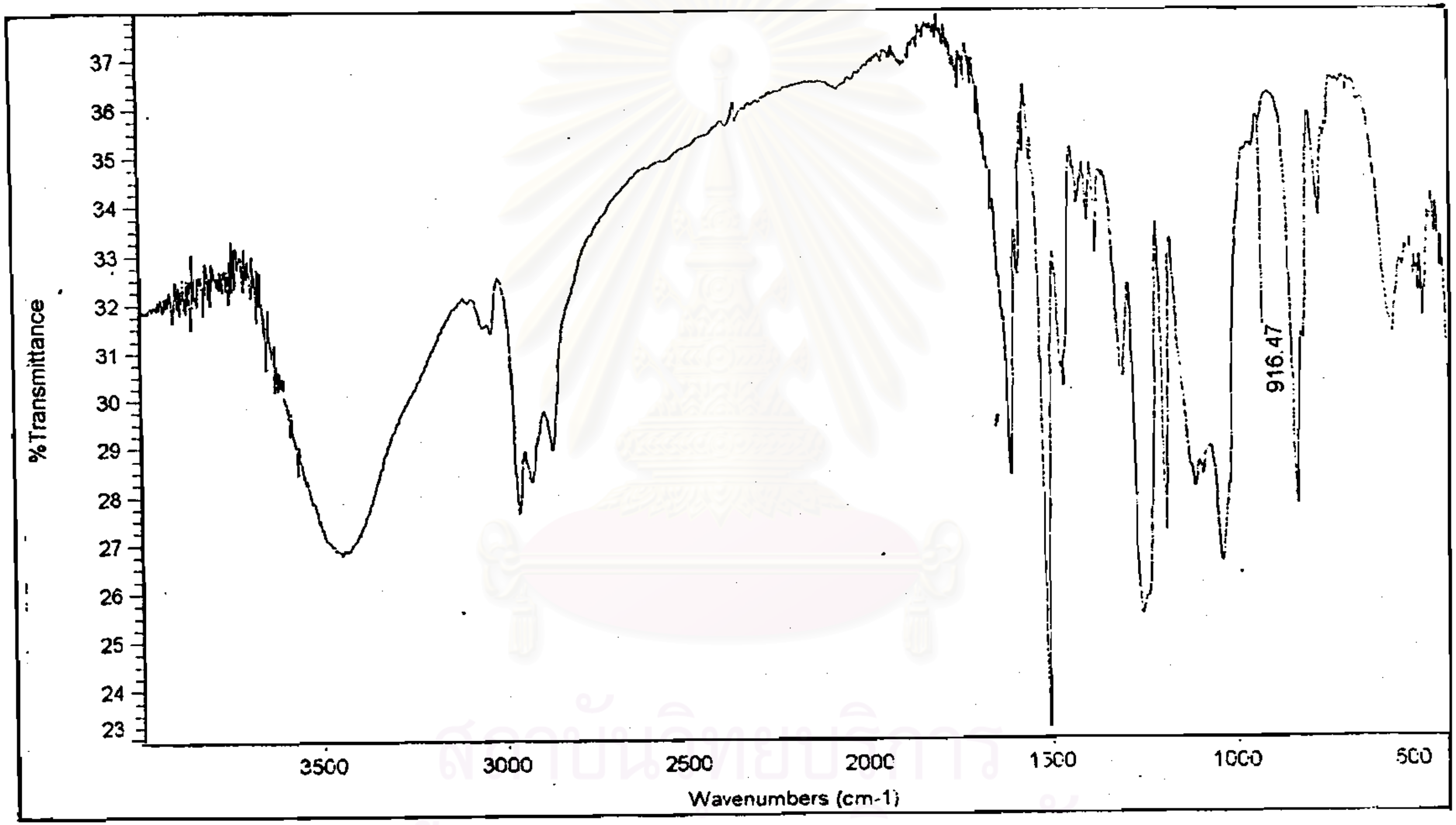

Figure A. 12 IR spectrum of Zn-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH

at the equivalent weight ratio of 1:6:0.2

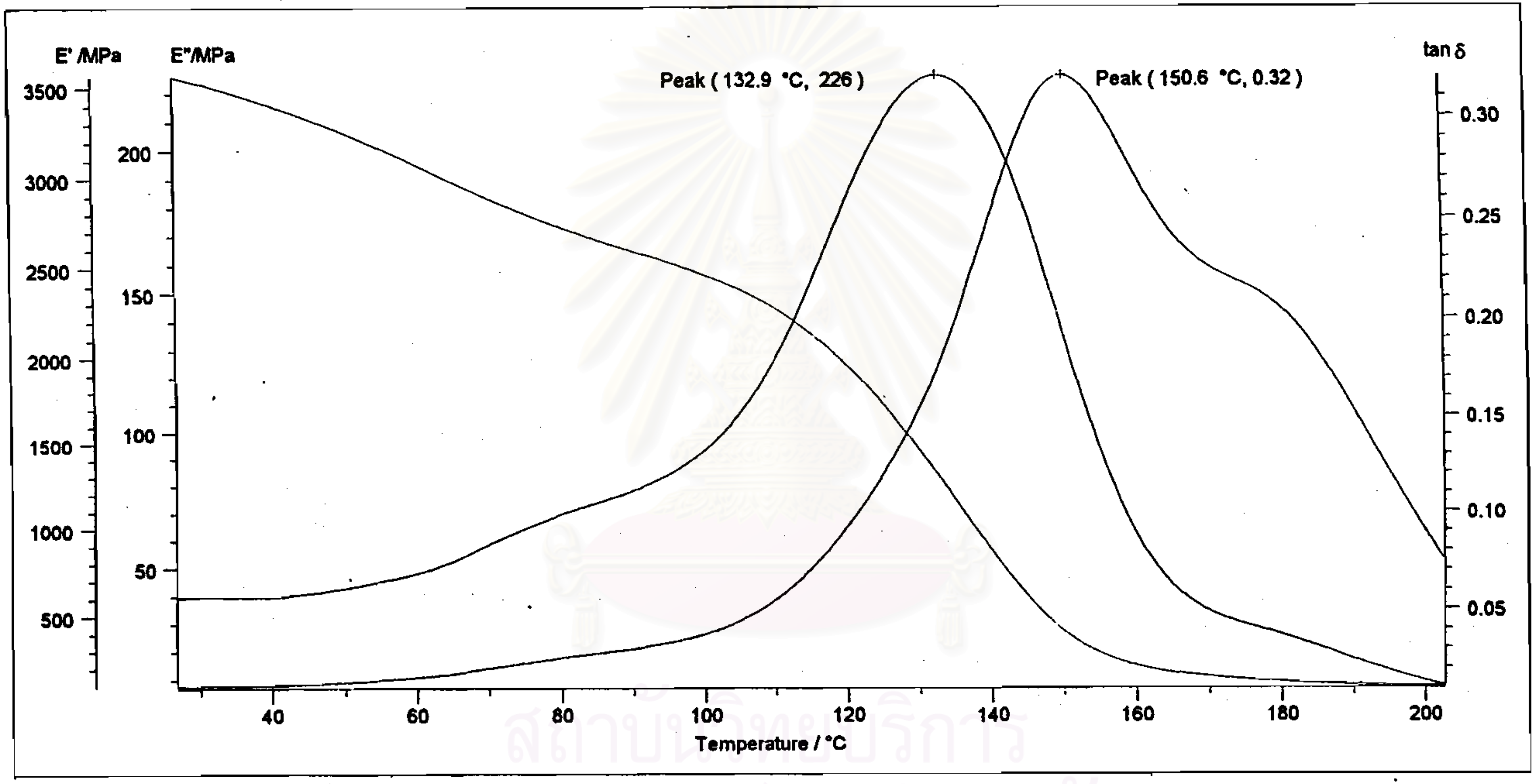

Figure A. 13 DMA thermogram of Ni-containing epoxy polymer of **NiL**:DGEBA at the equivalent weight ratio of 1:6

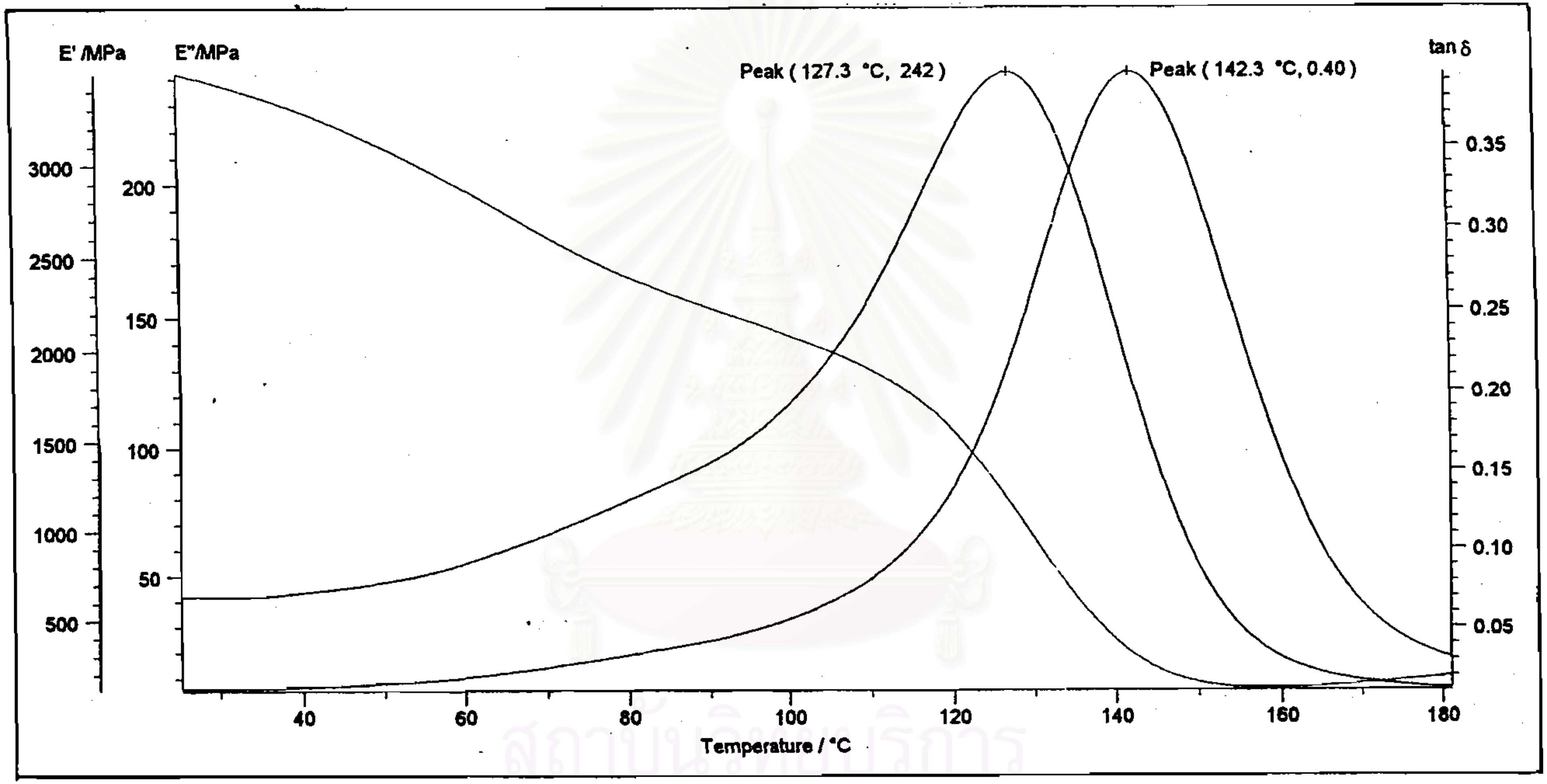

Figure A. 14 DMA thermogram of Ni-containing epoxy polymer of NiL:DGEBA at the equivalent weight ratio of 1:6:0.2

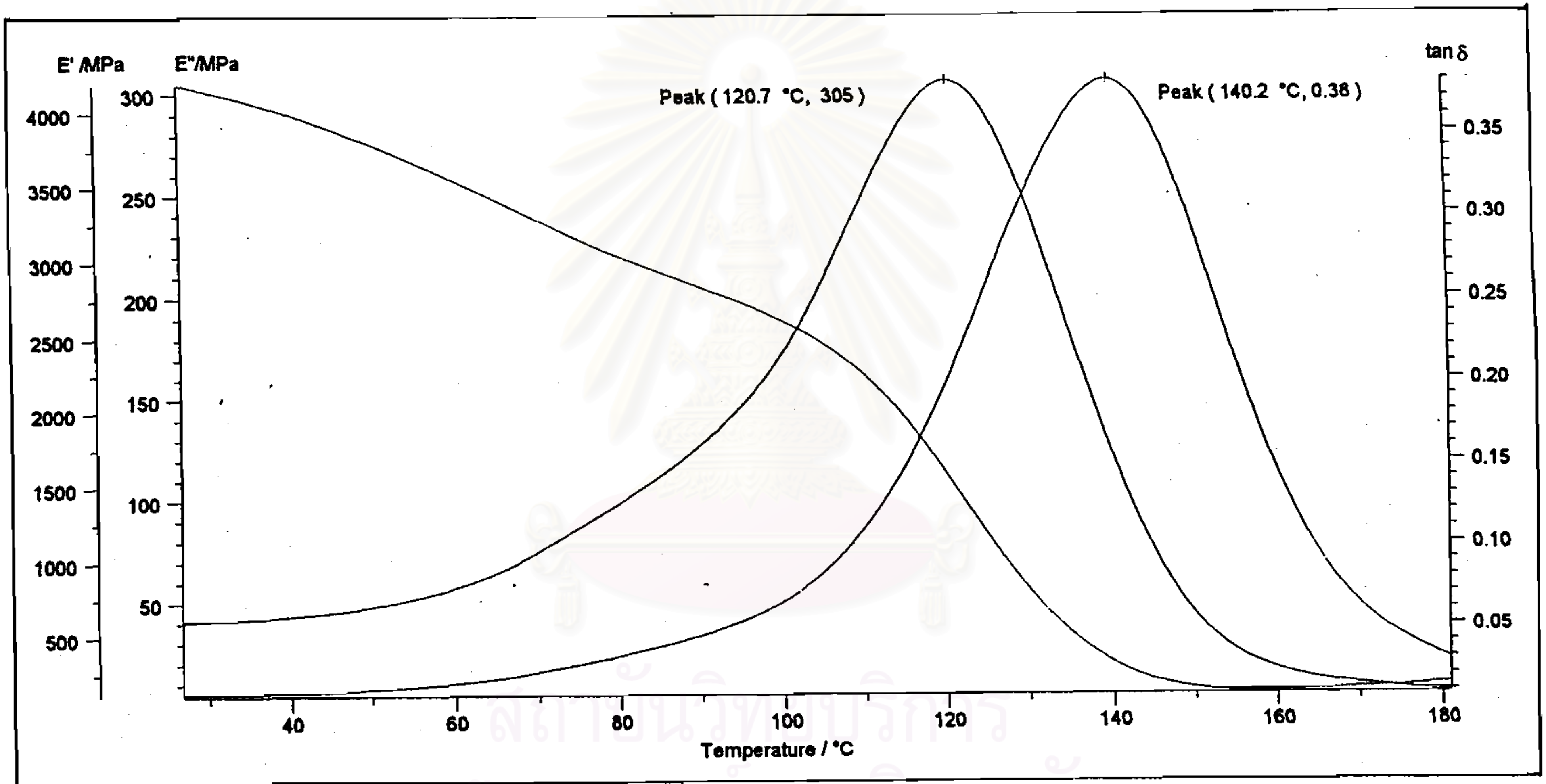

Figure A. 15 DMA thermogram of Ni-containing epoxy polymer of NiL:DGEBA:Bu_4NOH at the equivalent weight ratio of 1:8:0.2

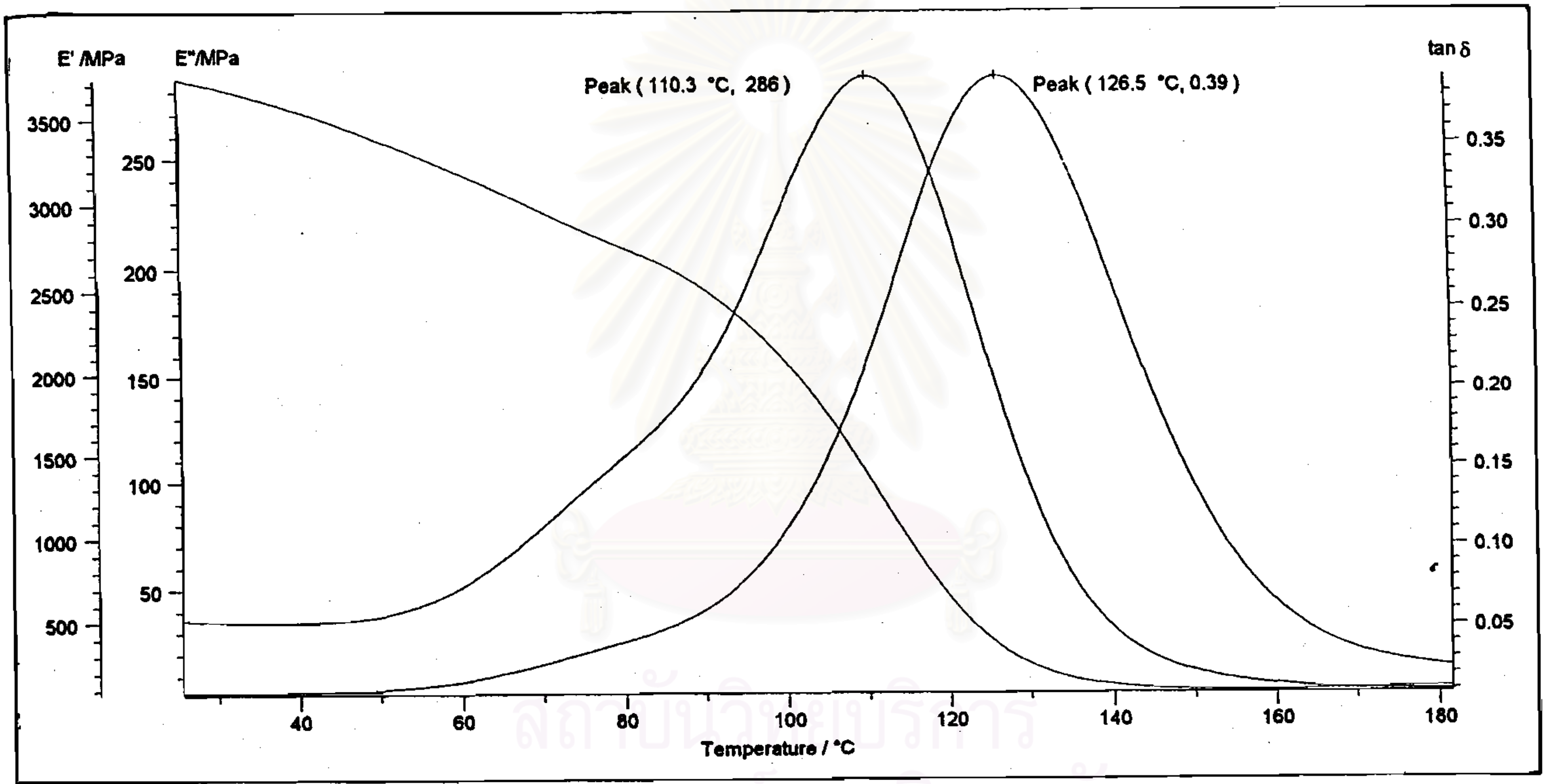

Figure A. 16 DMA thermogram of Ni-containing epoxy polymer of NiL:DGEBA:Bu_4NOH
at the equivalent weight ratio of 1:10:0.2

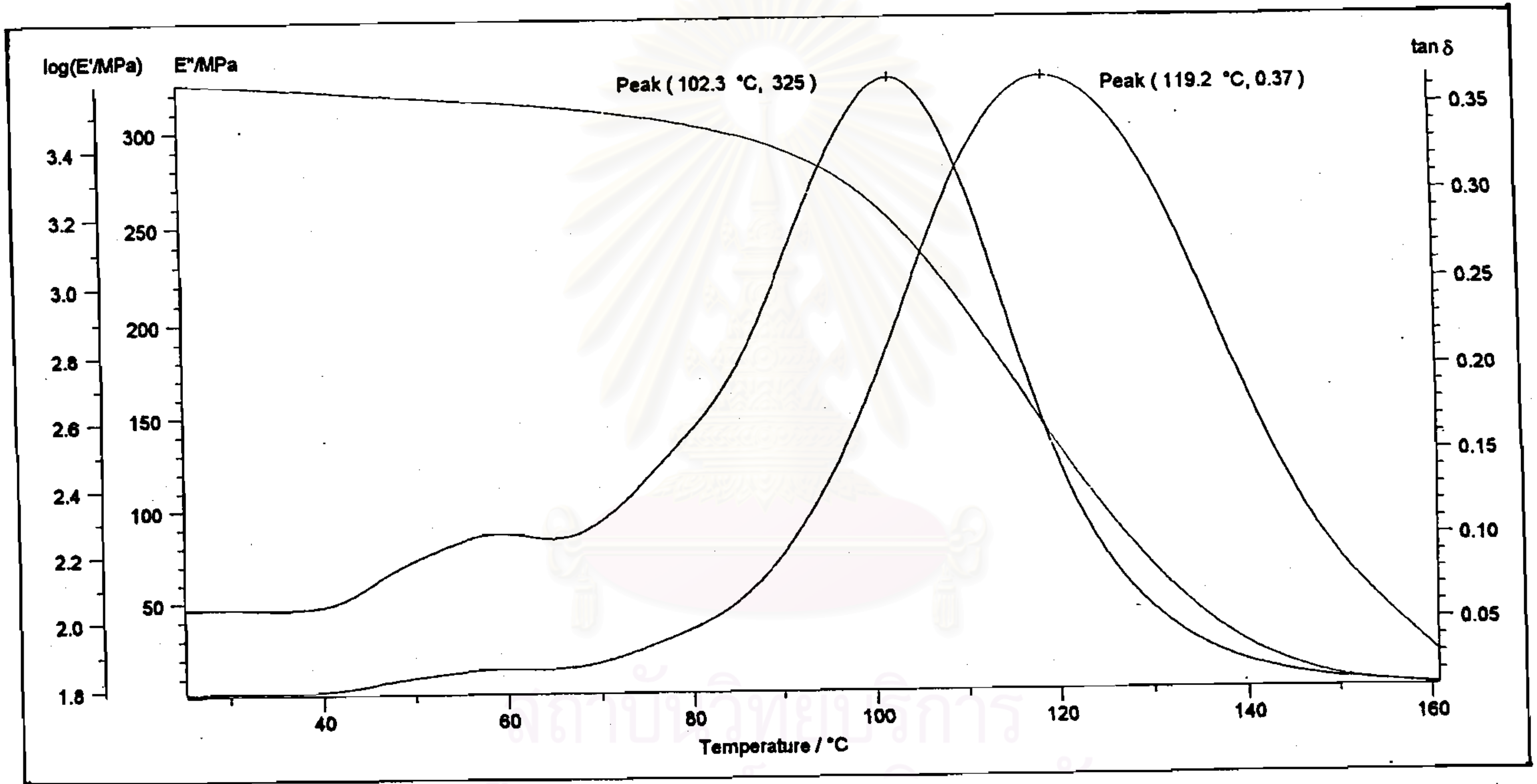

Figure A. 17 DMA thermogram of Ni-containing epoxy polymer of NiL:DGEBA:Bu_4NOH

at the equivalent weight ratio of 1:12:0.2

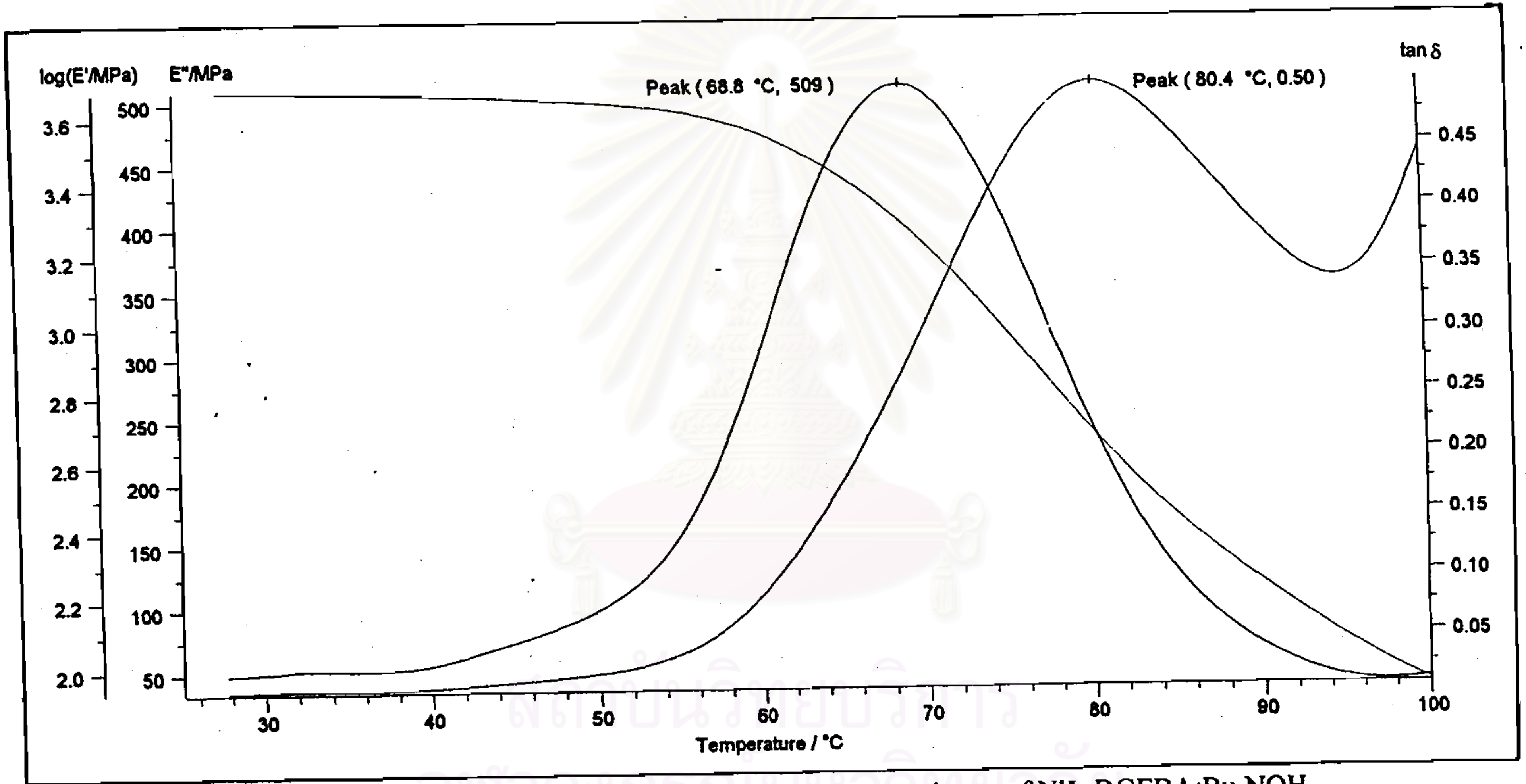

Figure A. 18 DMA thermogram of Ni-containing epoxy polymer of NiL:DGEBA:Bu_4NOH at the equivalent weight ratio of 1:14:0.2

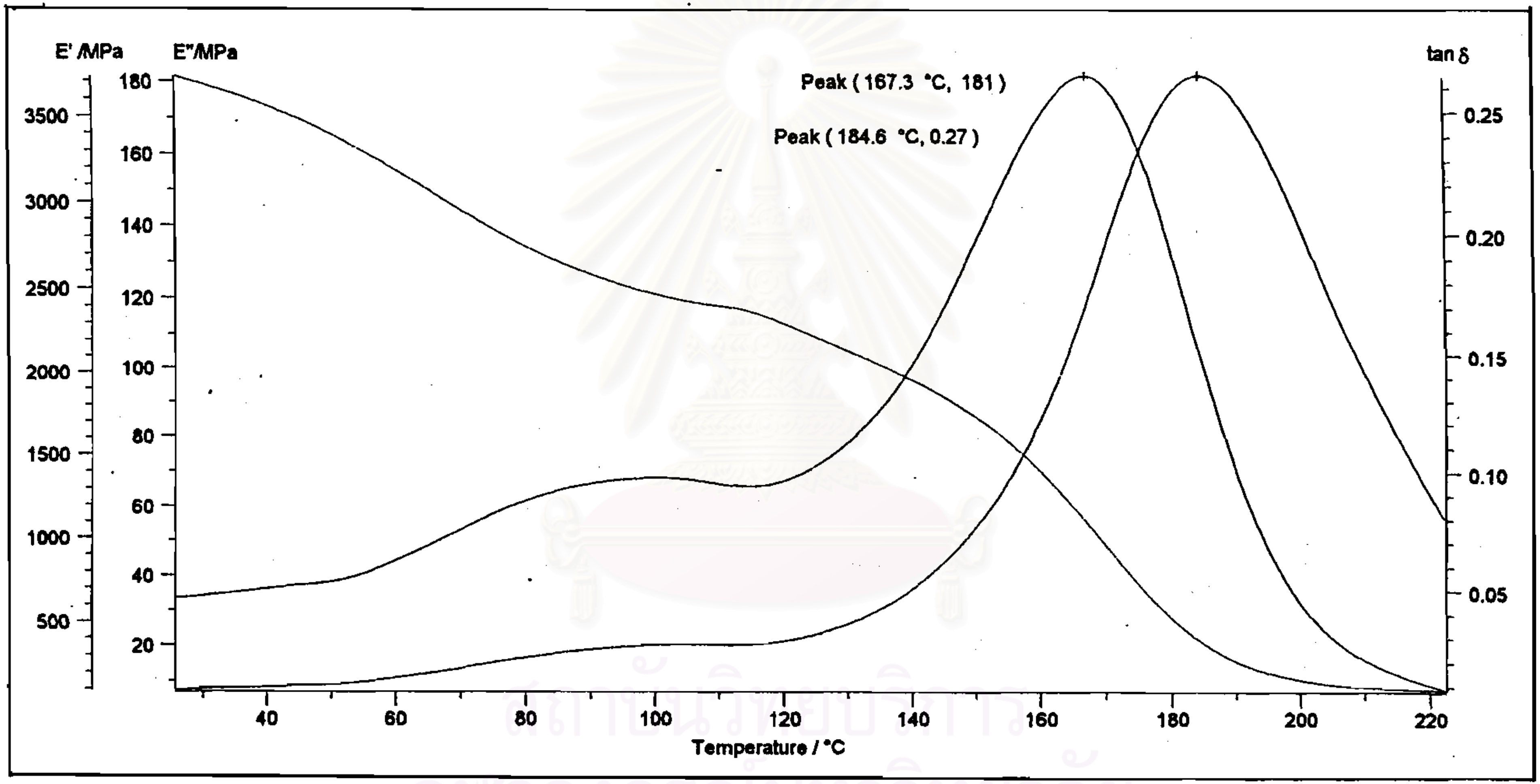

Figure A. 19 DMA thermogram of Zn-containing epoxy polymer of **ZnL**:DGEBA

at the equivalent weight ratio of 1:6

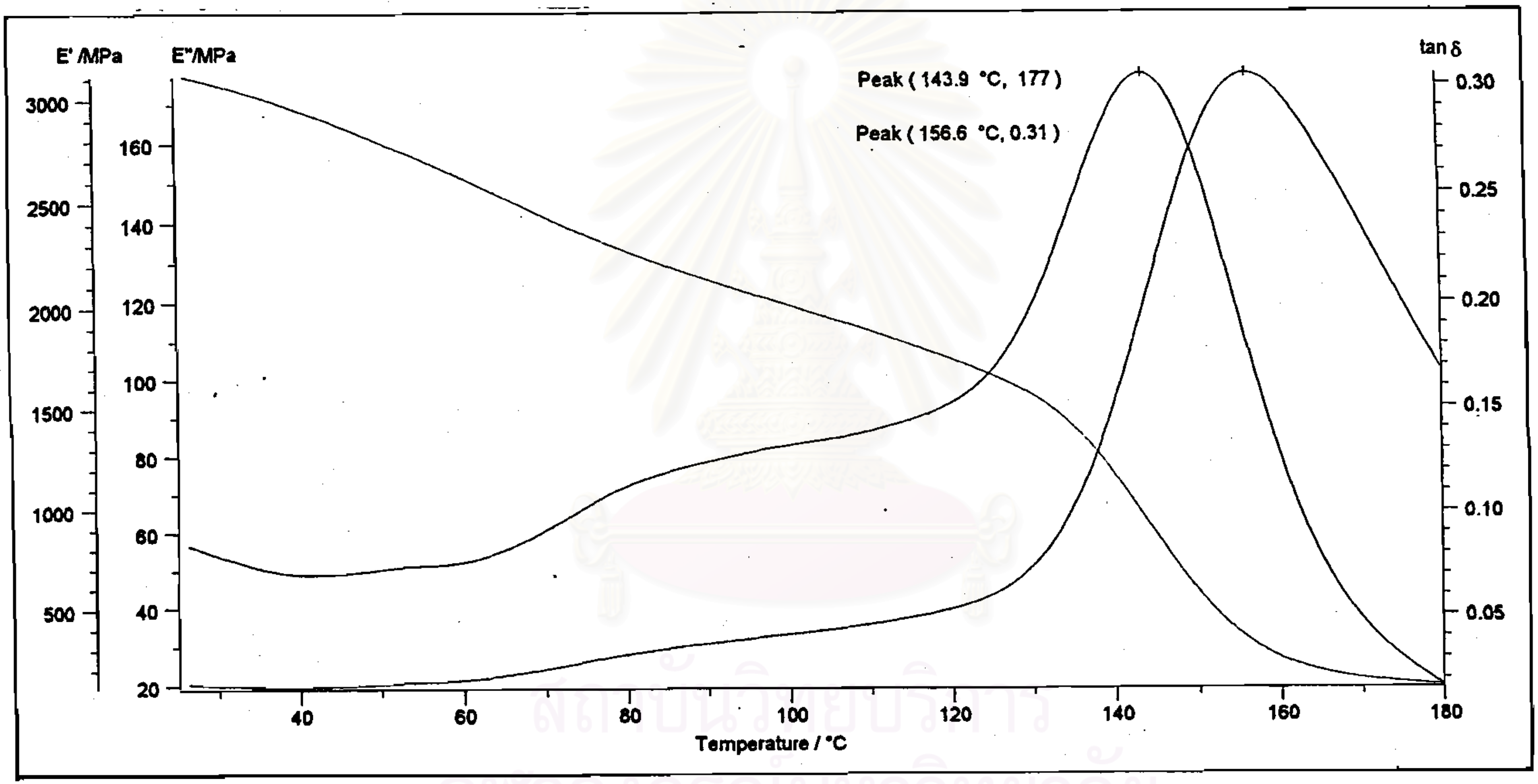

Figure A. 20 DMA thermogram of **ZnL**-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH

at the equivalent weight ratio of 1:6:0.2

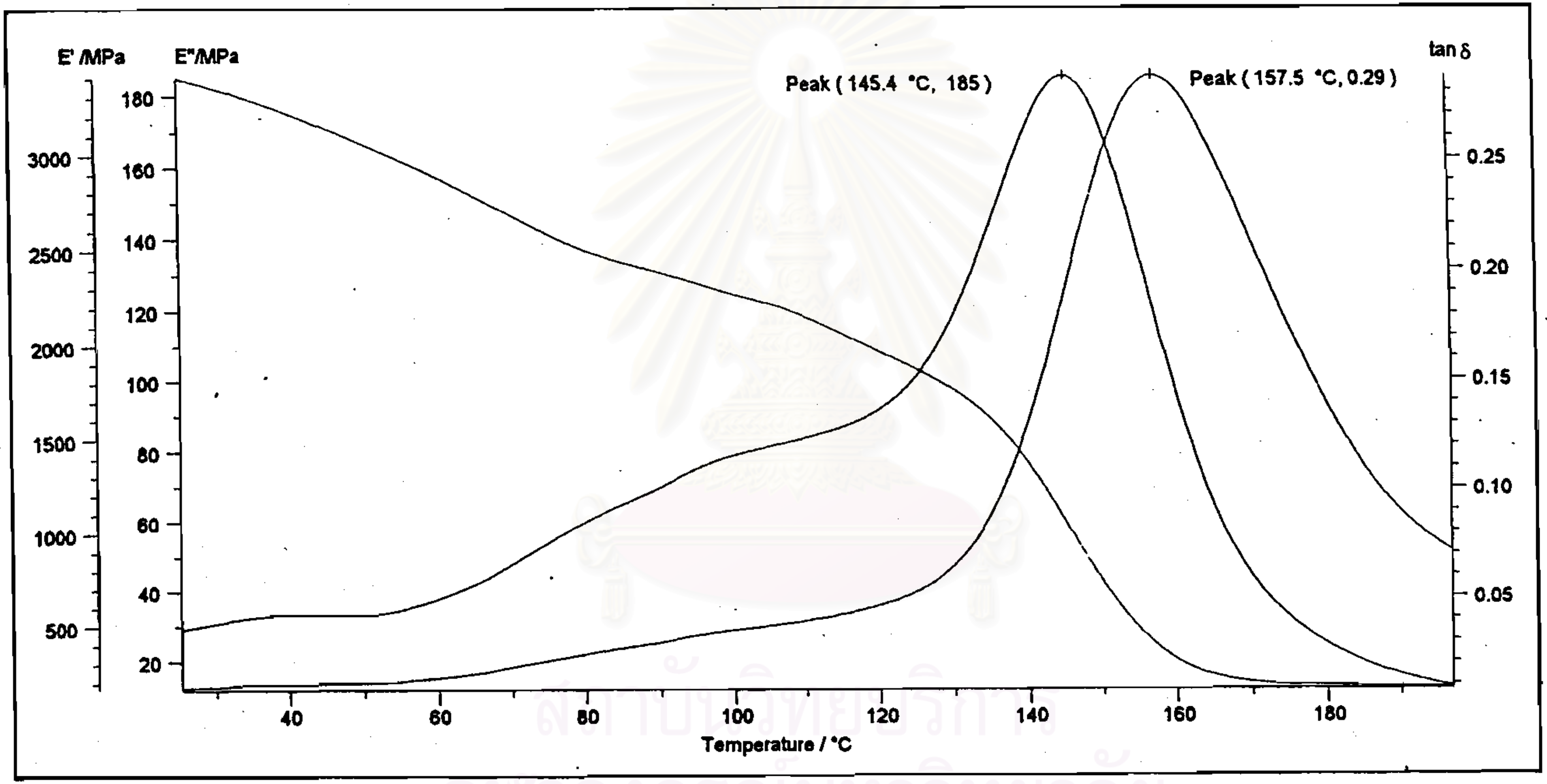

Figure A. 21 DMA thermogram of **ZnL**-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH

at the equivalent weight ratio of 1:8:0.2

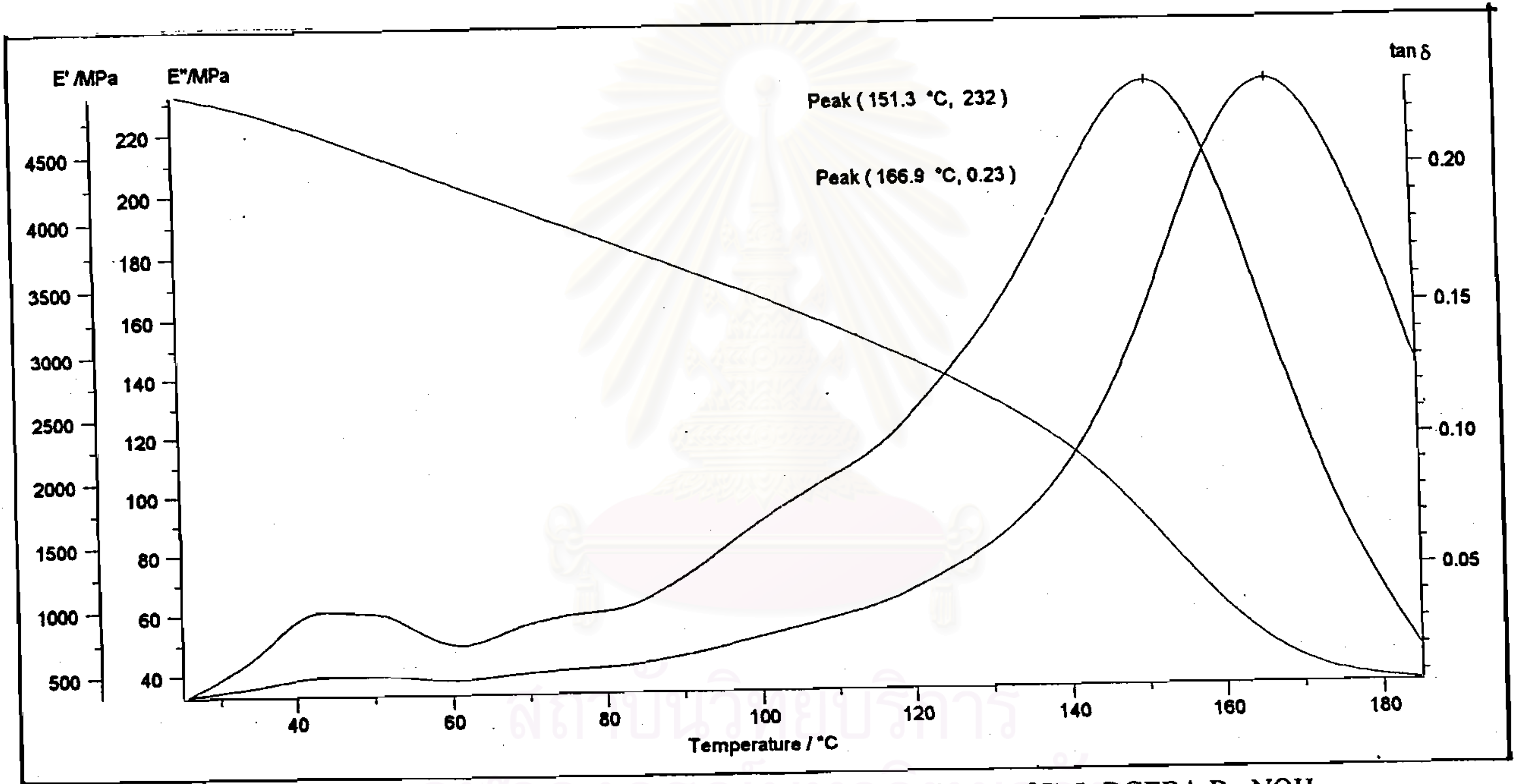

Figure A. 22 DMA thermogram of **ZnL**-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH

at the equivalent weight ratio of 1:10:0.2

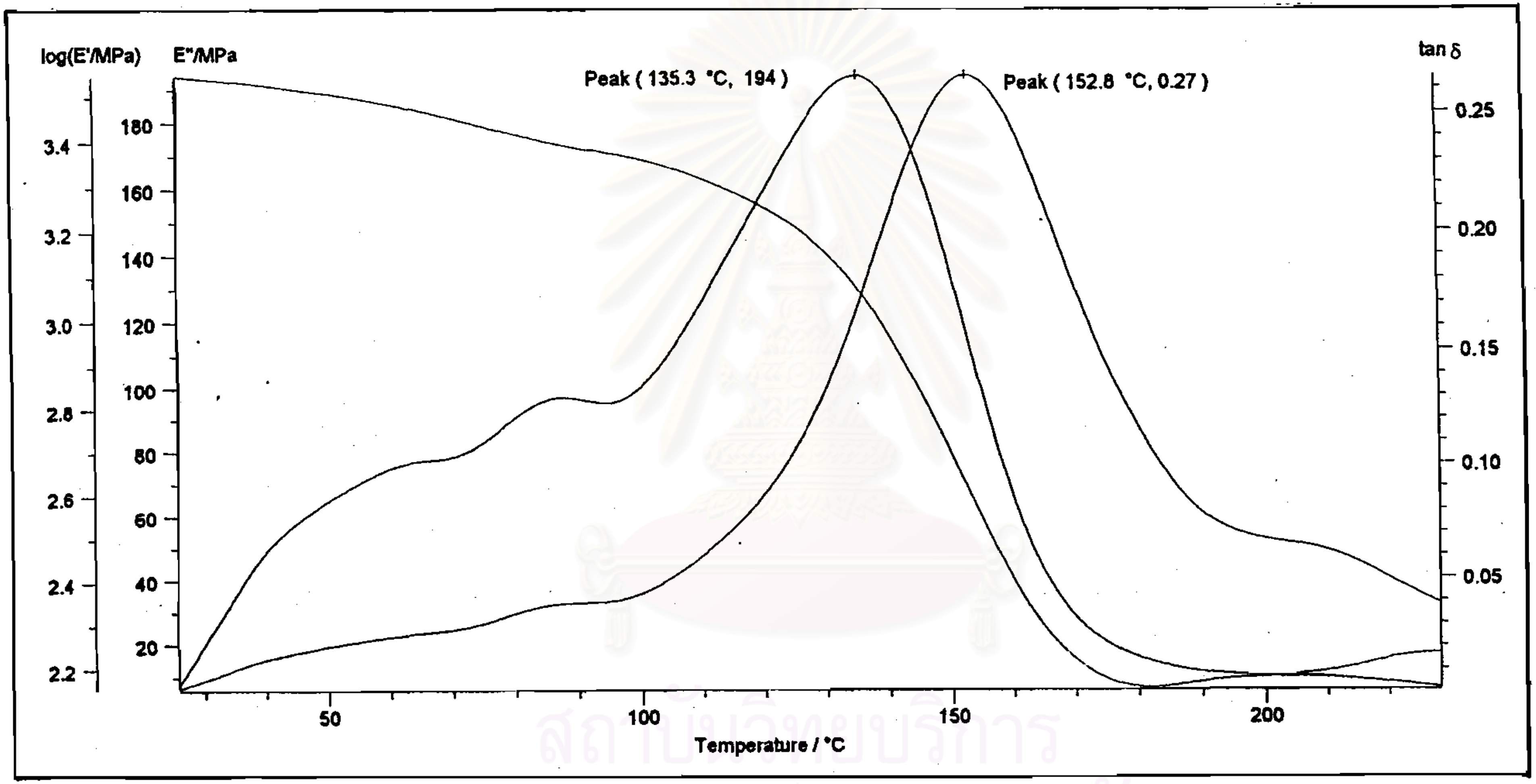

Figure A. 23 DMA thermogram of **ZnL**-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH at the equivalent weight ratio of 1:12:0.2

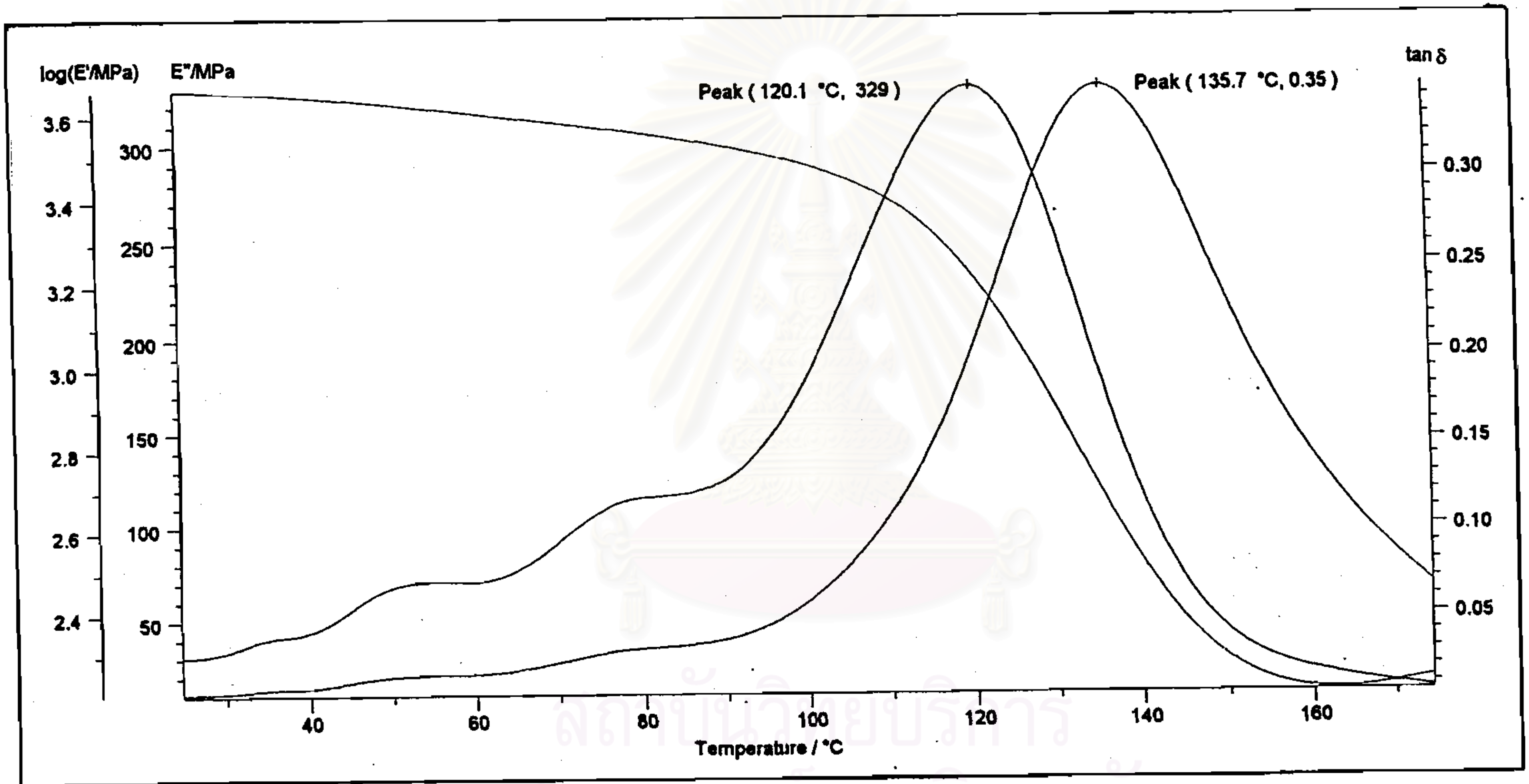

Figure A. 24 DMA thermogram of **ZnL**-containing epoxy polymer of **ZnL**:DGEBA:Bu_4NOH at the equivalent weight ratio of 1:14:0.2

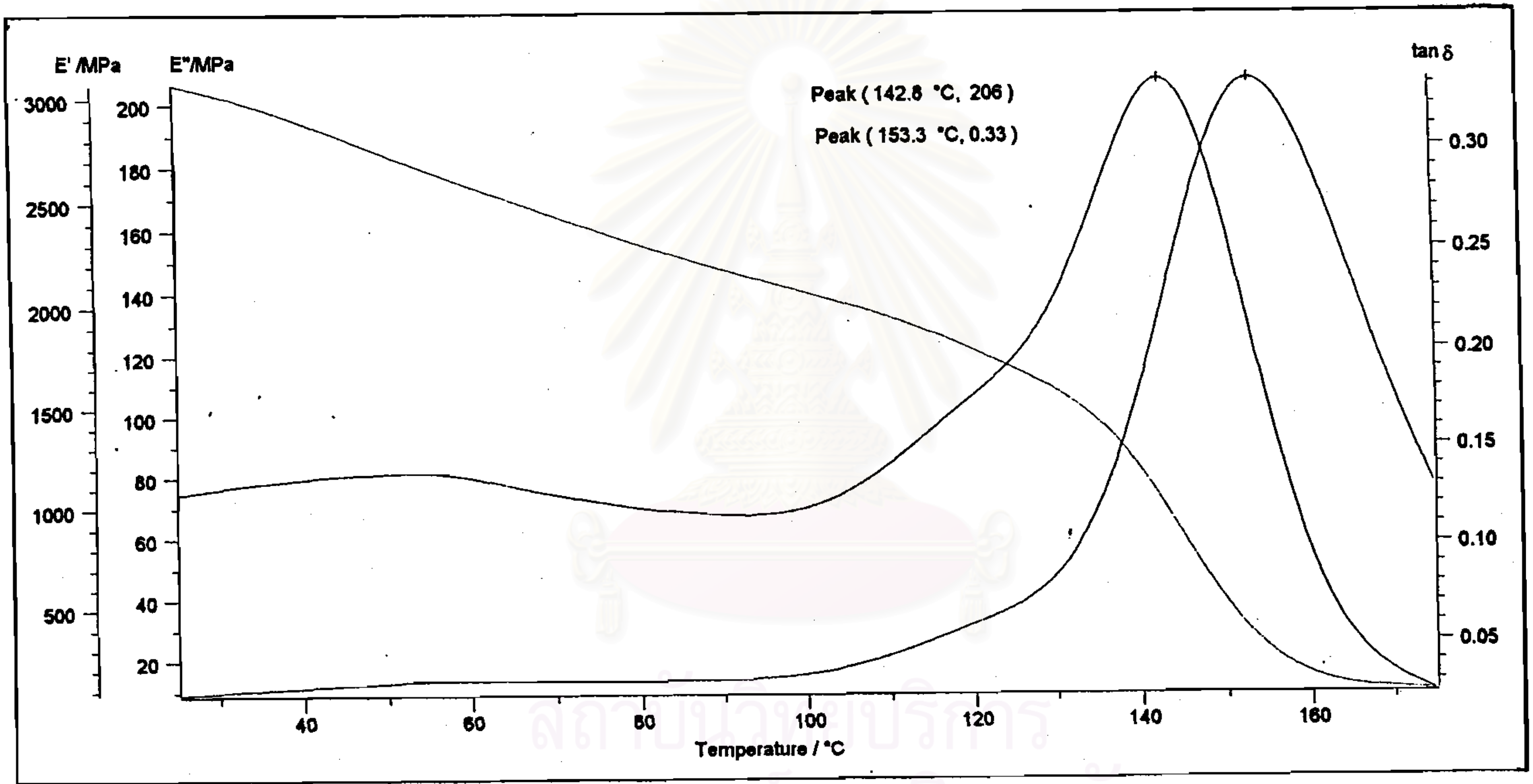

Figure A. 25 DMA thermogram of epoxy polymer obtained from DGEBA and maleic anhydride

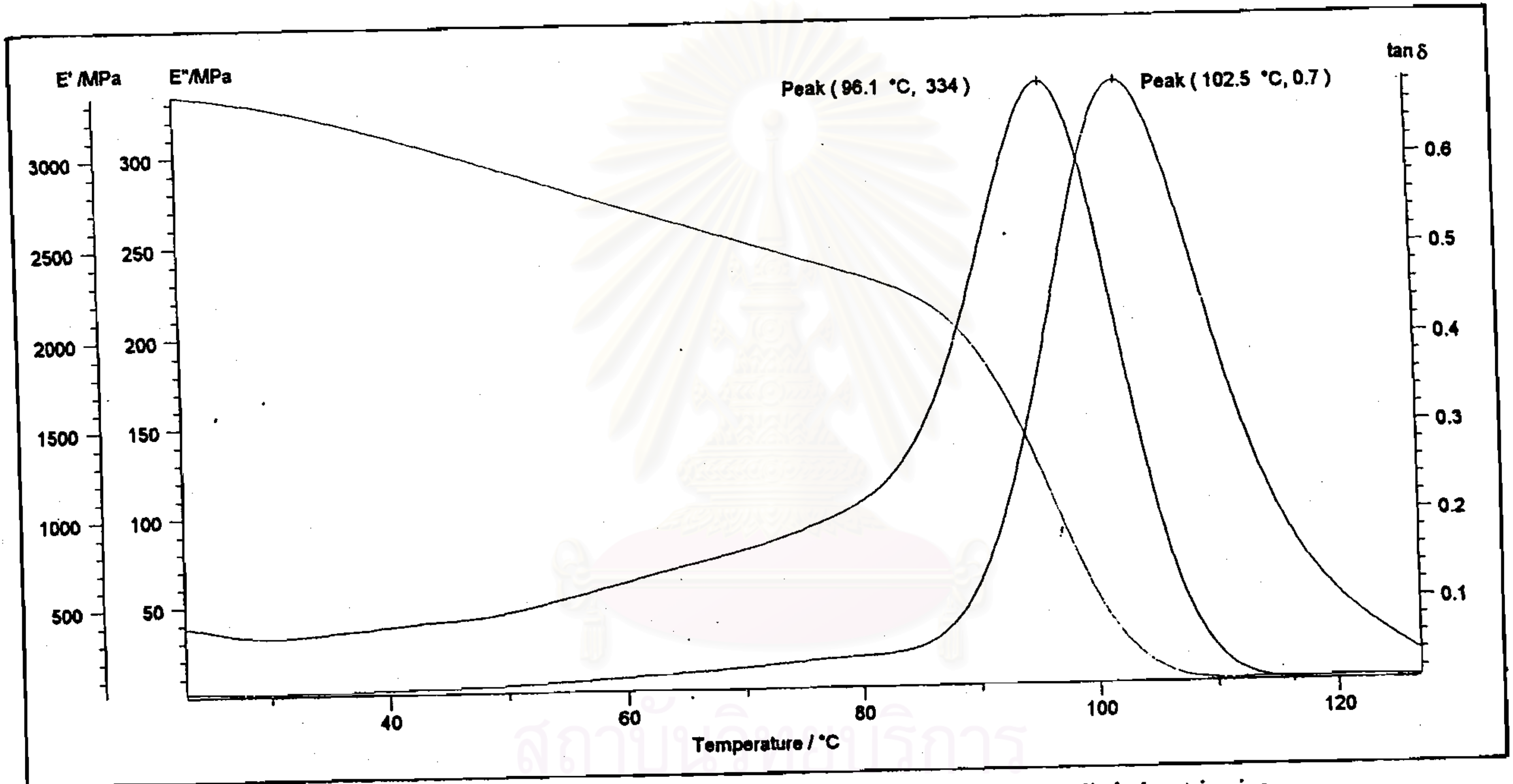

Figure A. 26 DMA thermogram of epoxy polymer obtained from DGEBA and diethylenetriamine

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