Ejemplos reales de comportamiento caótico

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Characteristic time series and operation region of the system of two tank reactors (CSTR) with variable division of recirculation stream

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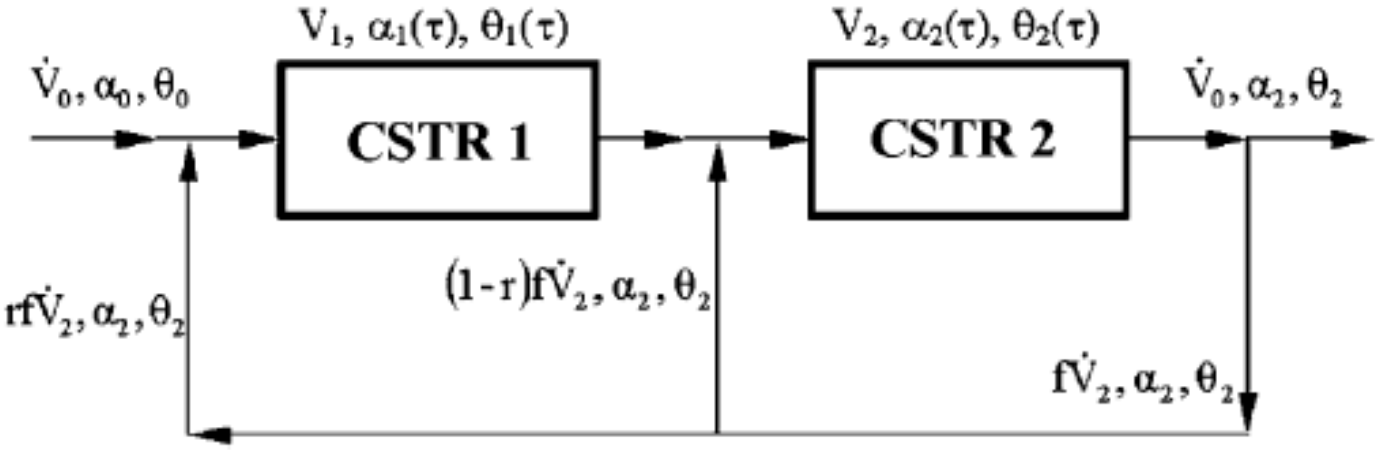
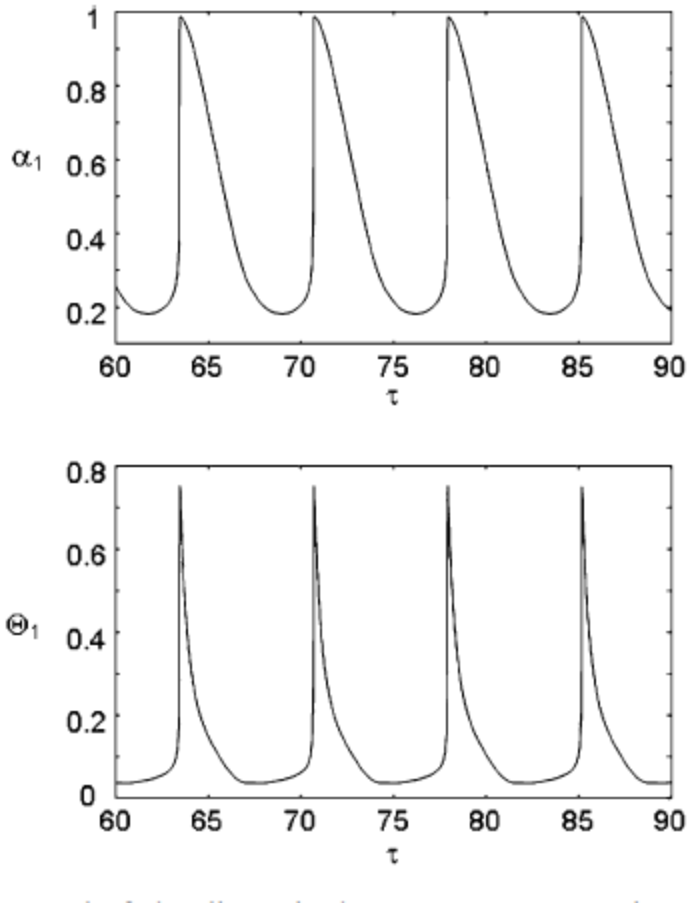


conversion degree, $[\alpha = (C_0 - C)/C_0]$



Temperatura adimensionalizada

Fig. 2. Variation of the conversion degree and of the dimensionless temperature vs. time for the first reactor and $\tau_0 = 0.0$, $f = 0.2$, $r = 0.3$.

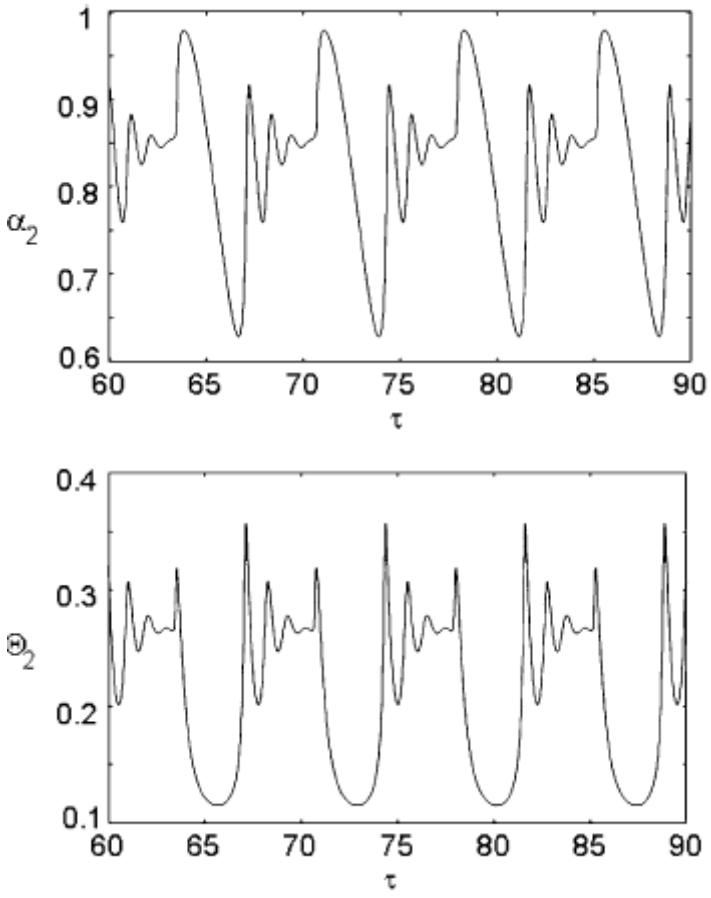


Fig. 3. Variation of the conversion degree and of the dimensionless temperature vs. time for the second reactor and $\tau_0 = 0.0$, $f = 0.2$, $r = 0.3$.

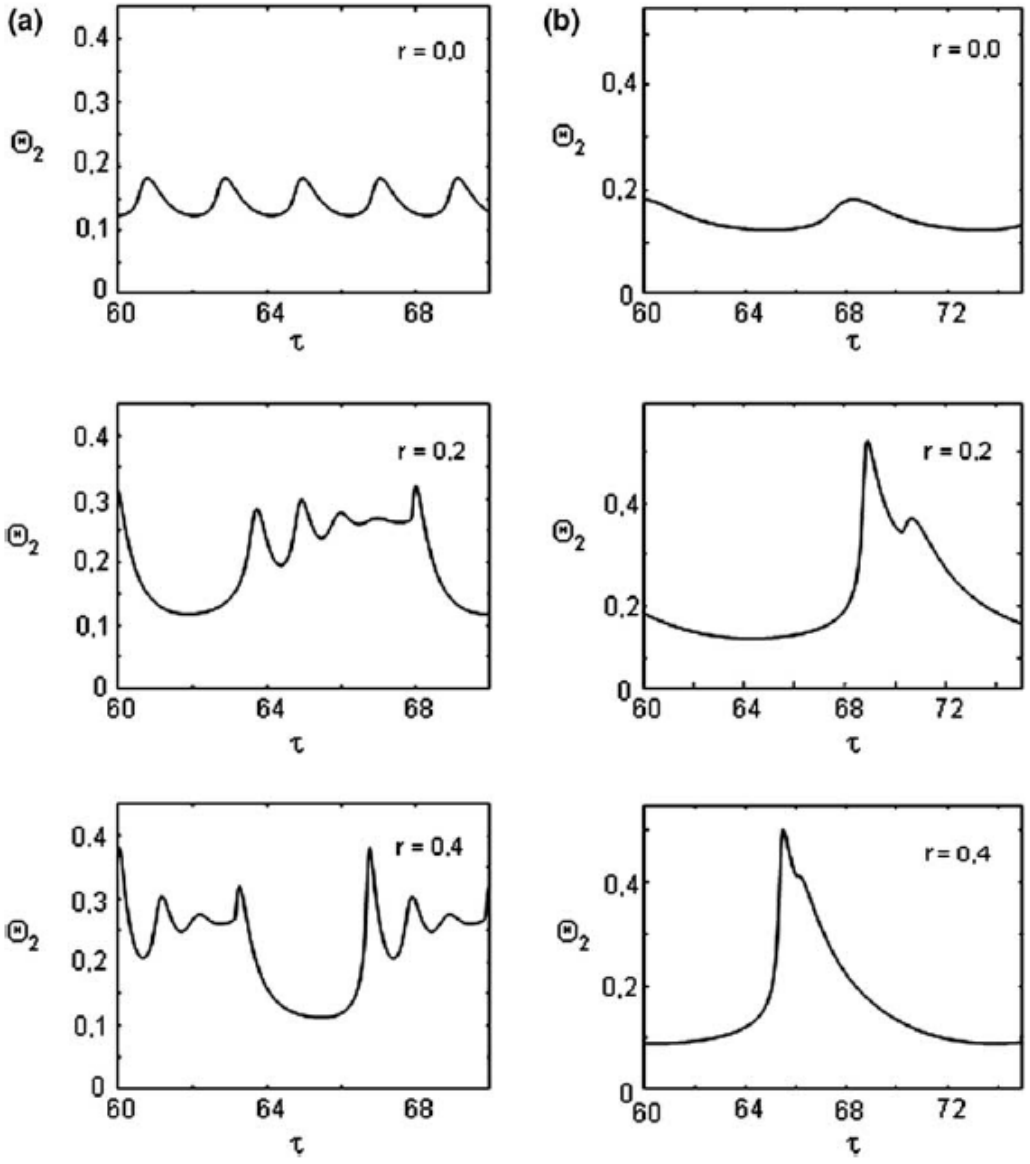


Fig. 6. Variation of the dimensionless temperature vs. time for the second reactor. (a) $\tau_0 = 0.0$, $f = 0.2$, $r = 0.0$; 0.2; 0.4; (b) $\tau_0 = 0.0$, $f = 0.8$, $r = 0.0$; 0.2; 0.4.

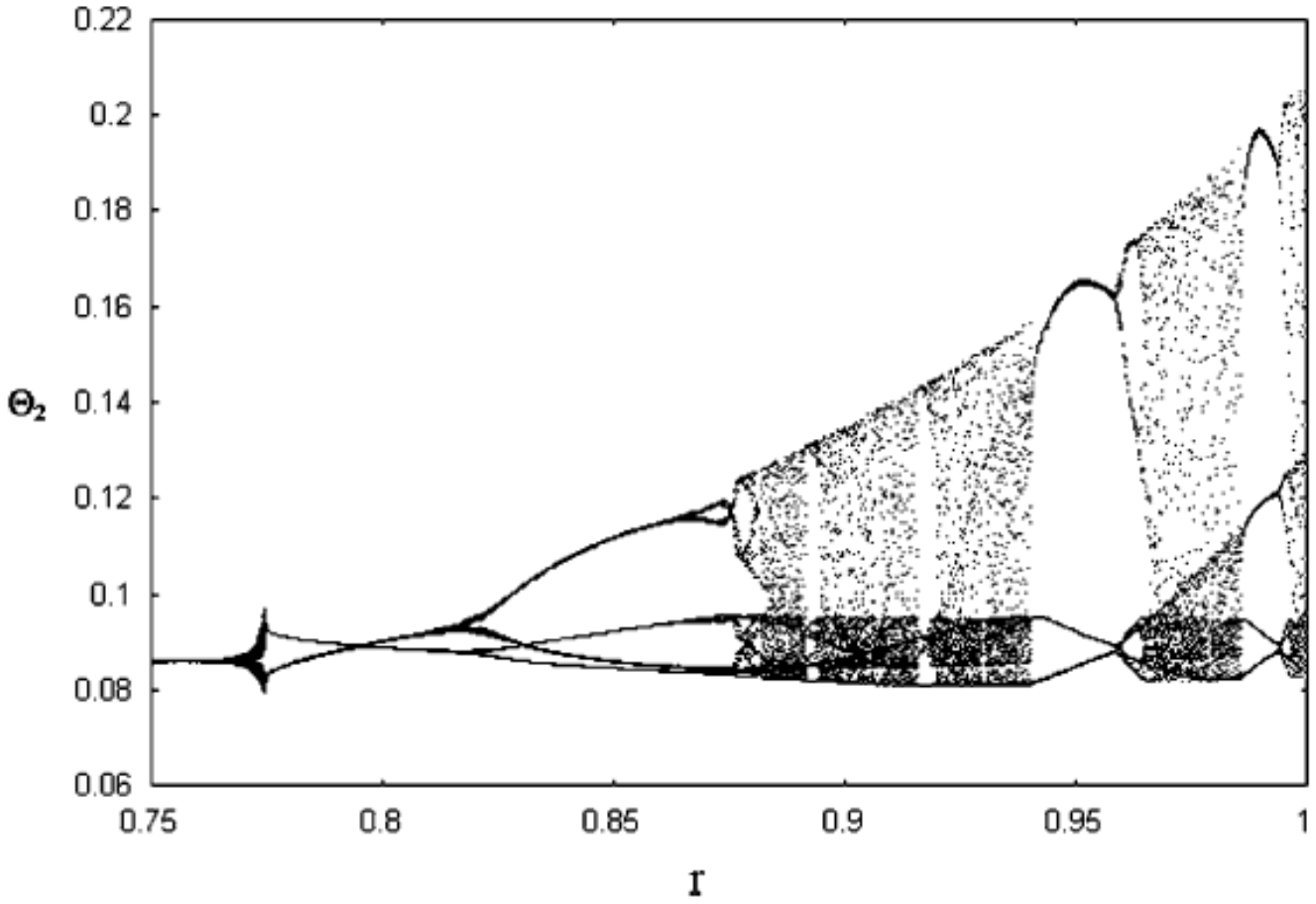


Fig. 7. Feigenbaum diagram as a function of r (ratio of division of recirculation) for $\tau_0 = 0.05$, $f = 0.20$, $\sigma_2 = 2$.

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Chaotic dynamics of a cascade of plug flow tubular reactors (PFTRs) with division of recirculating stream

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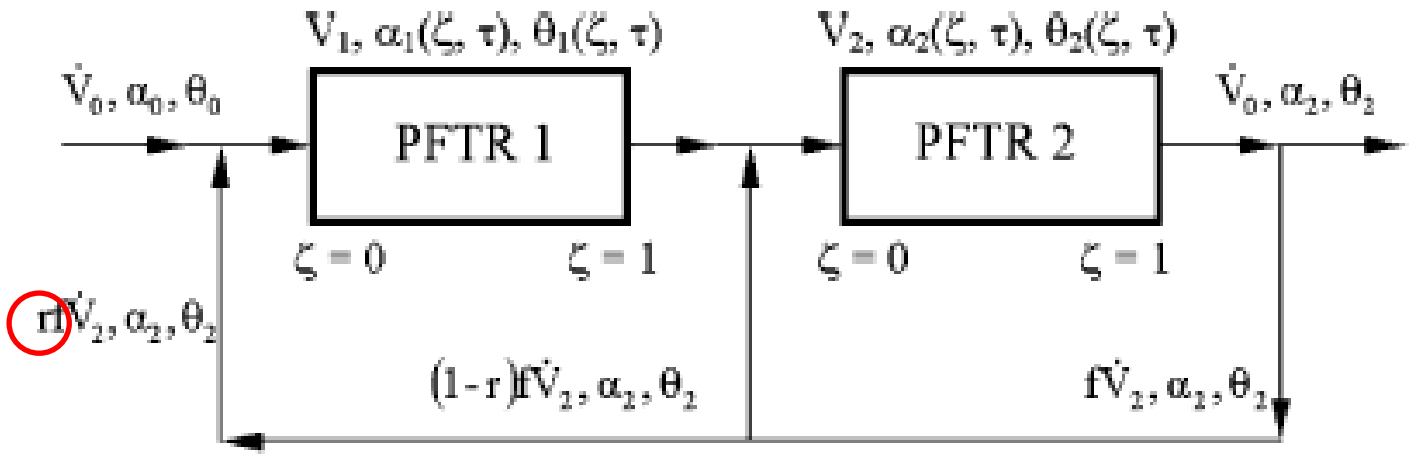
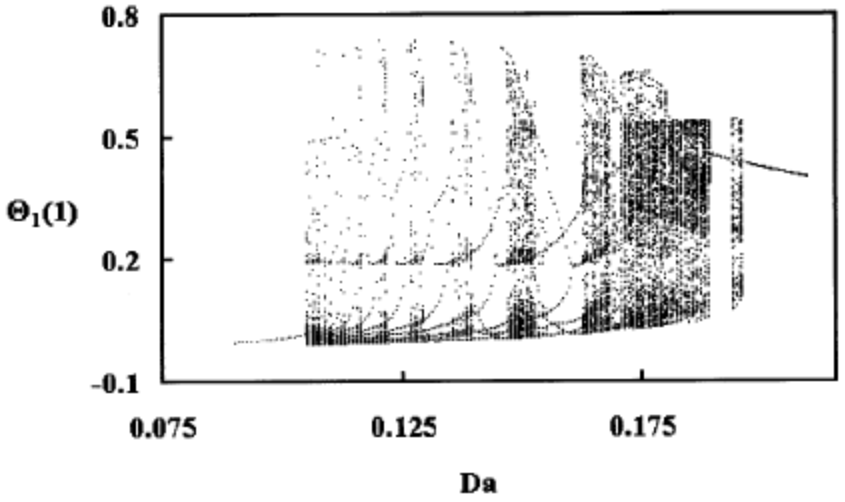
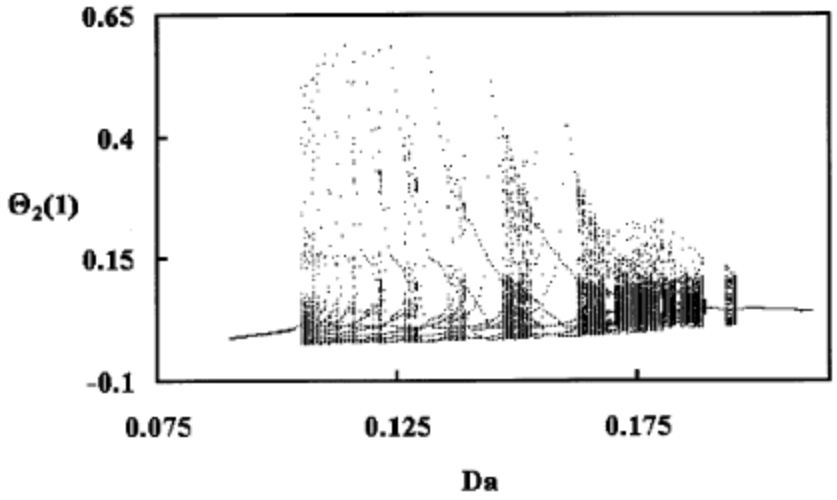


Temperaturas adimensionalizadas





Da Damköhler number, $[Da = V_i r_0/(FC_0)]$

Al cambiar el potencial o aumentar el espesor

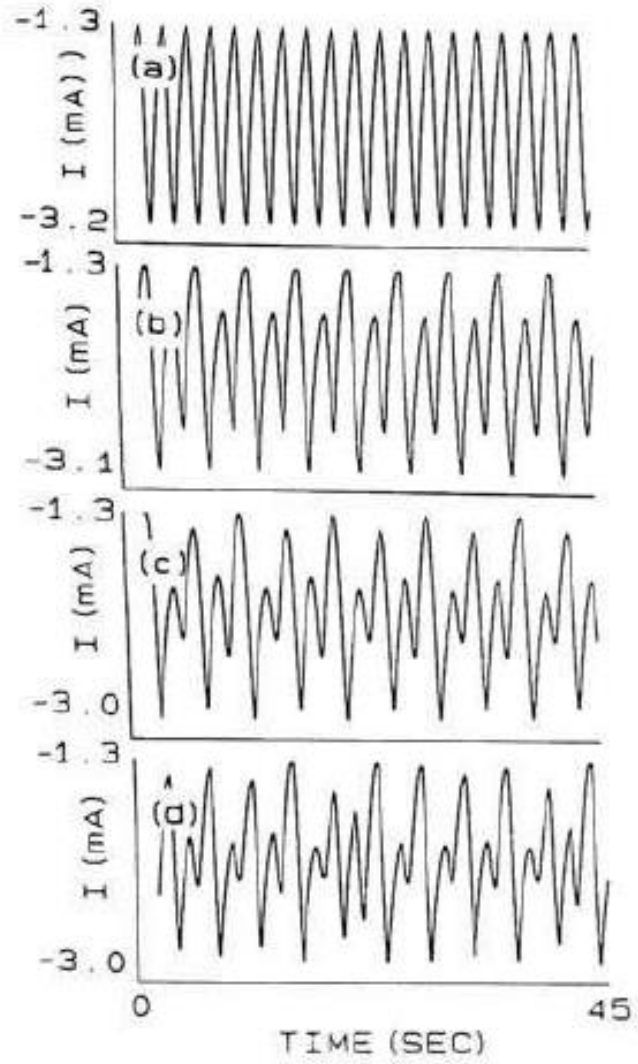


Figure 5.1. Period doubling during the electrodissolution of copper in phosphoric acid: (a) Period one; (b) Period two; (c) Period four; (d) Chaos. Reproduced by permission from F.N. Albahadily and M. Schell, *J. Chem. Phys.* **88** (1988) 4312.

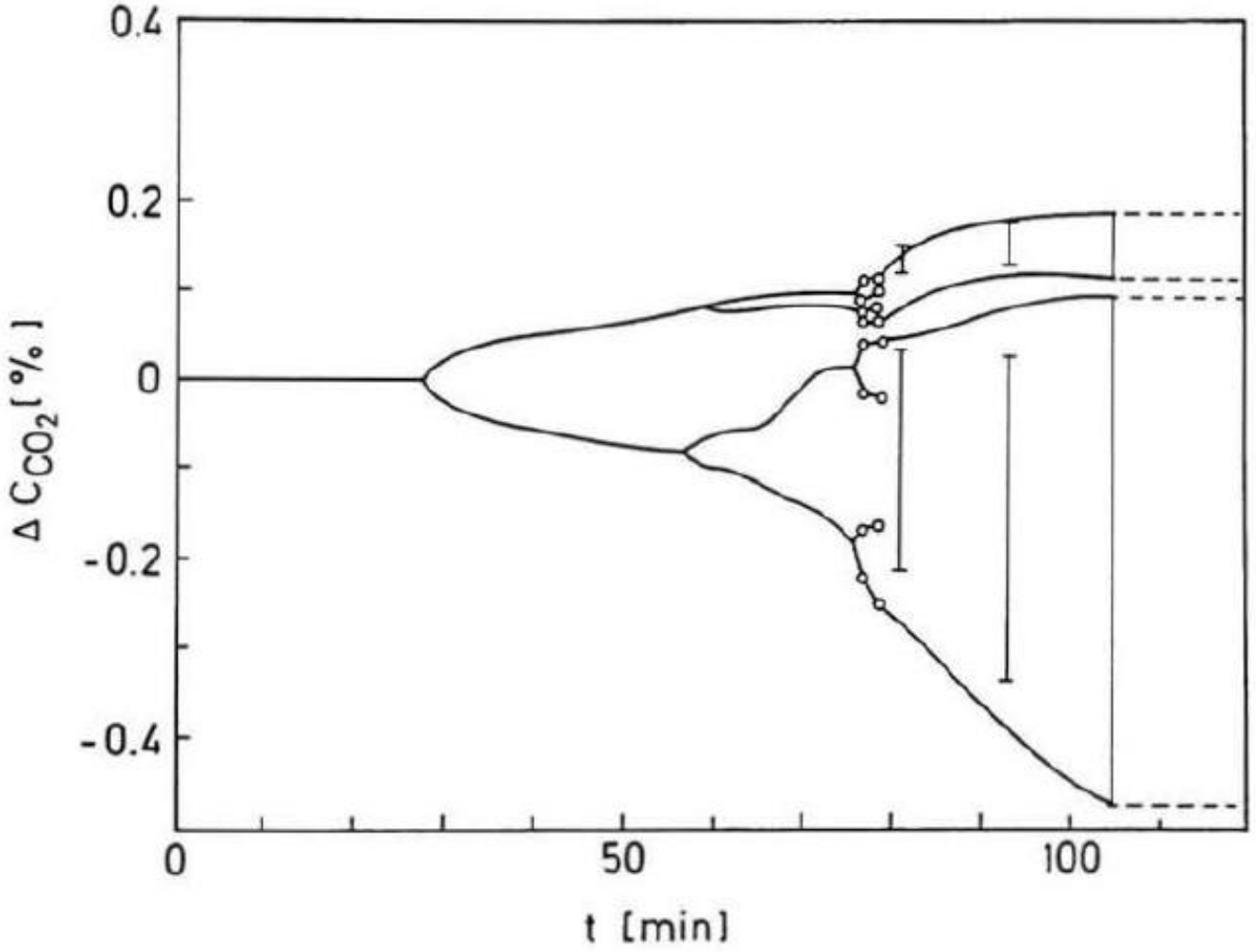


Figure 6.1. Bifurcation diagram of a period-doubling transition to chaos in the CO oxidation on a slowly changing Pt/Al_2O_3 catalyst. The maxima and minima of the outlet CO_2 concentration are shown *vs* time (which plays the role of the control parameter because of the slow change in the catalyst activity). Vertical bars indicate a continuous distribution of extrema. After J. Kapicka and M. Marek, *Surf. Sci.* **222** (1989) 885.

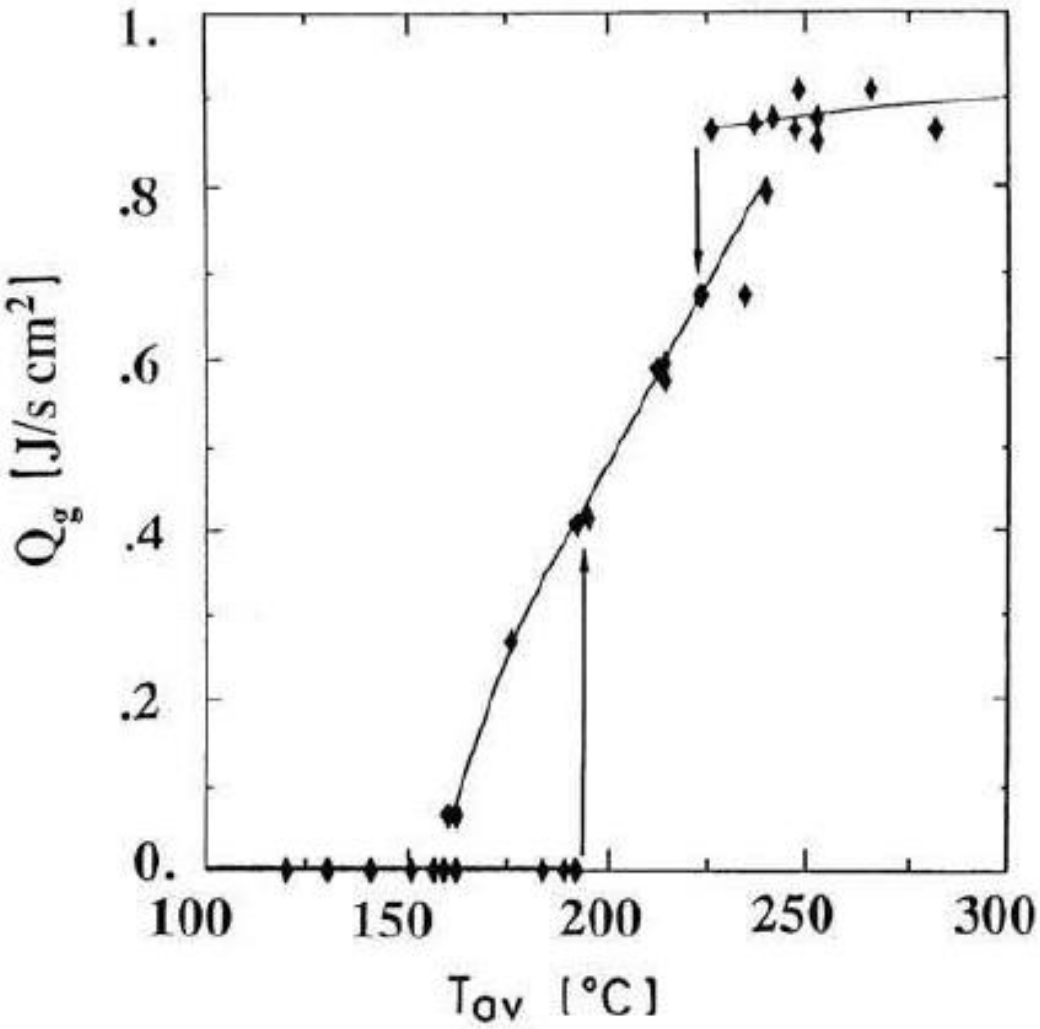


Figure 6.6. A bifurcation diagram showing the rate of heat generation by the oxidation of NH_3 on a Pt ribbon *vs* average catalyst temperature, T_{av}. The middle branch corresponds to a state with a standing temperature front (1% NH_3 in air). After L. Lobban, G. Philippou and D. Luss, *J. Phys. Chem.* **93** (1989) 733.

Reacción de la peroxidasa

The overall stoichiometry which we refer to as the PO reaction is:

$$2YH_2 + O_2 \rightarrow 2Y + 2H_2O,$$

where YH_2 is an organic electron donor. If YH_2 is NADH the reaction becomes:

$$2NADH + 2H^+ + O_2 \rightarrow 2NAD^+ + 2H_2O \qquad (7.1)$$

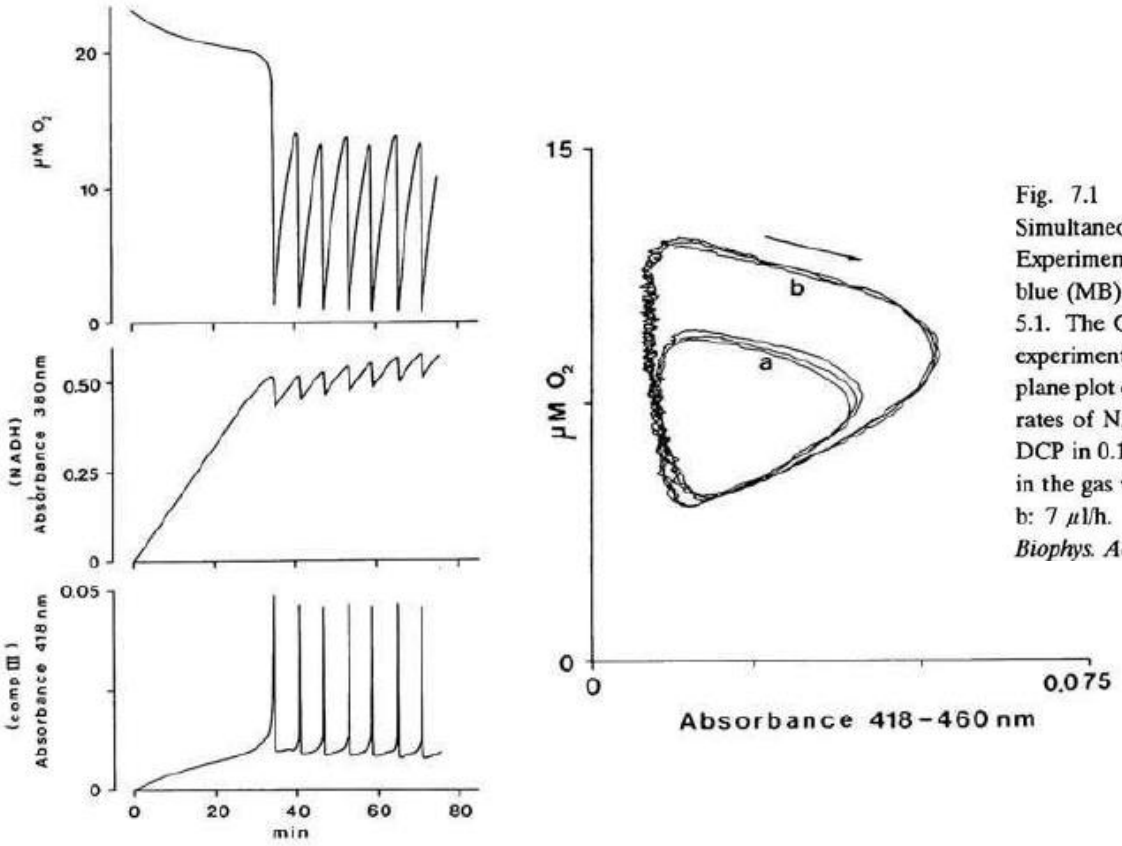


Fig. 7.1 a-left) Oscillatory behavior in the peroxidase-NADH-O_2 reaction. Simultaneous measurements of concentrations of O_2, NADH and coIII. Experimental conditions: 0.9 μM horseradish peroxidase (HRP); 0.2 μM methylene blue (MB) and 10 μM 2,4-dichlorophenol (DCP) in 0.1 M Na-acetate buffer, pH = 5.1. The O_2 content in the gas was 1.9% by volume. Temperature = 28 °C. The experiment was started by infusion of 0.2 M NADH at a rate of 11 μl/h. b) Phase-plane plot of O_2 concentration against concentration of coIII at two different infusion rates of NADH. Experimental conditions: 1.8 μM HRP, 0.6 μM MB and 20 μM DCP in 0.1 M Na-acetate buffer, pH = 5.1. Temperature = 25 °C. The O_2 content in the gas was 1.8% by volume; 0.2M NADH was infused at rates of a: 11 μl/h; and b: 7 μl/h. Reproduced by permission from L.F. Olsen and H. Degn, *Biochim. Biophys. Acta* 523 (1978) 321.

3 Free Radical Polymerization of Vinyl Acetate

The free radical polymerization of vinyl acetate, $CH_3CO_2CH : CH_2$ is based on the following mechanism:

- Initiation

$I \longrightarrow 2R^{\cdot}$ with rate constant k_{trm}

$R^{\cdot} + M \longrightarrow P_1^{\cdot}$ with rate constant k_i

- Propagation

$P_n^{\cdot} + M \longrightarrow P_{n+1}^{\cdot}$ with rate constant k_p

- Chain Transfer to Monomer

$P_n^{\cdot} + M \longrightarrow M_n + P_1^{\cdot}$ with rate constant k_{trm}

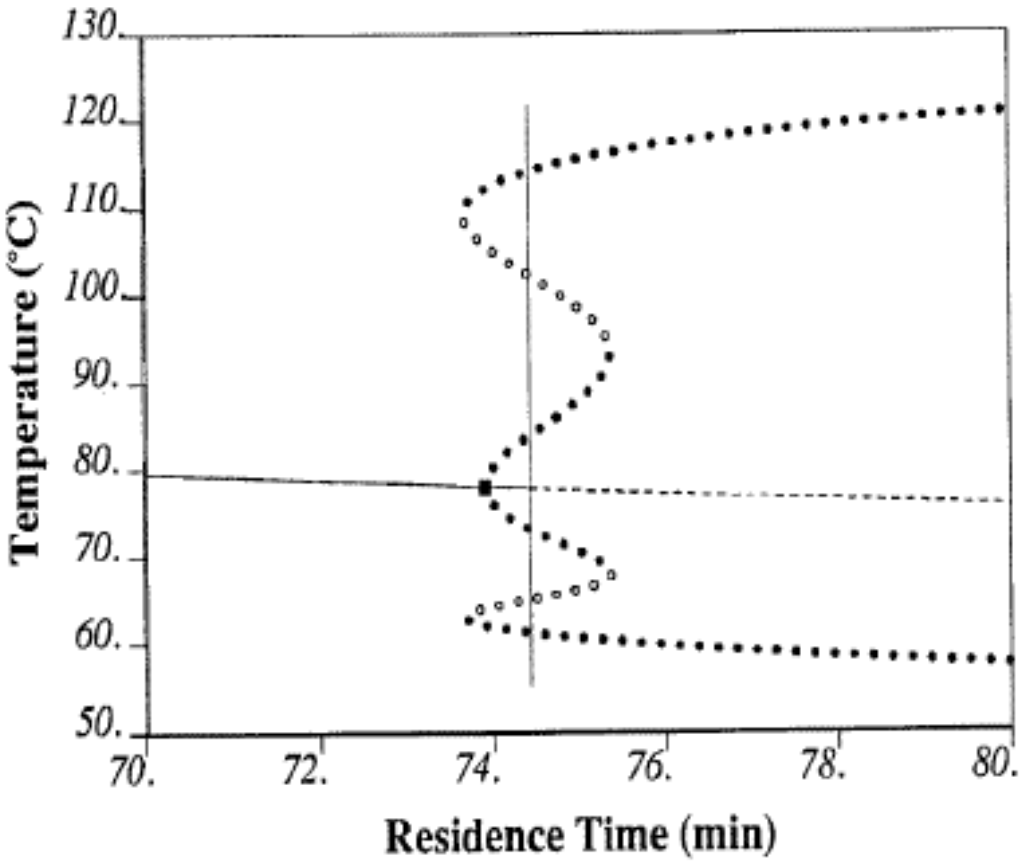
- Chain Transfer to Solvent

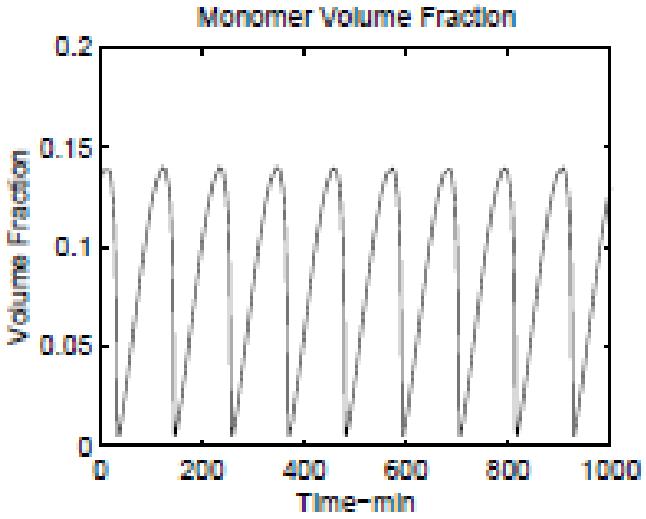
$P_n^{\cdot} + S \longrightarrow M_n + S_1^{\cdot}$ with rate constant k_{trs}

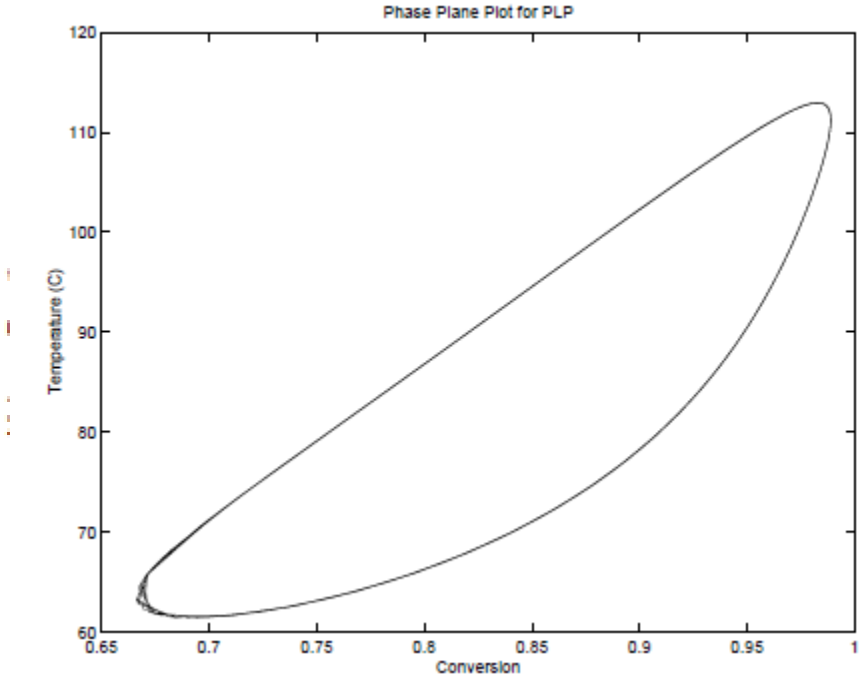
- Dead Polymer Termination

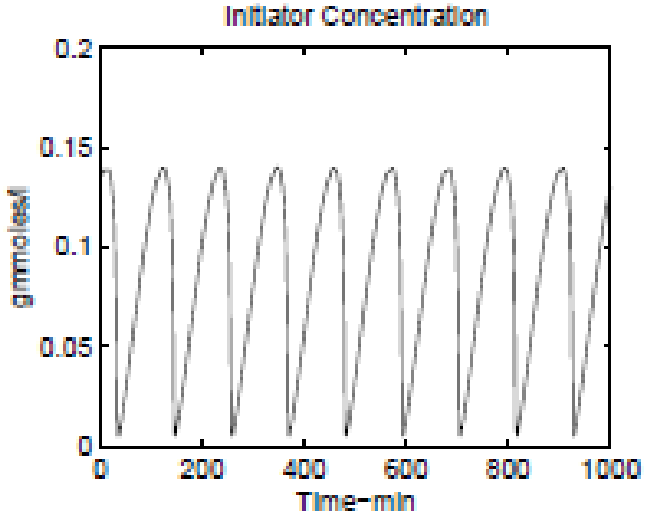
$P_n^{\cdot} + P_m^{\cdot} \longrightarrow$ termination with rate constant k_t

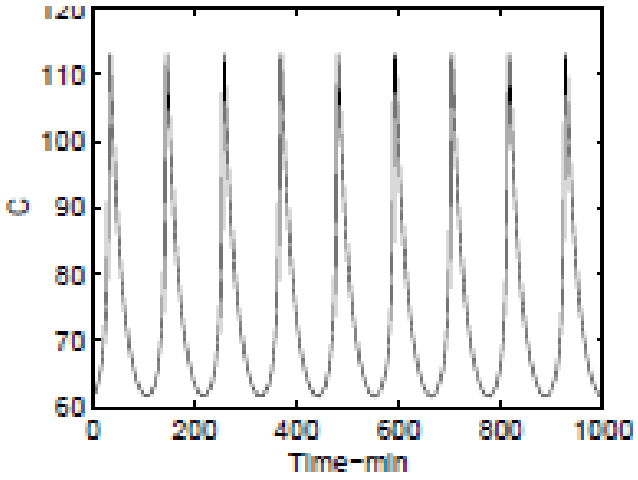
The reaction is carried out in a full-scale continuous and semi-batch industrial reactor. The initiator for the reaction is AIBN and and the solvent t-butanol.

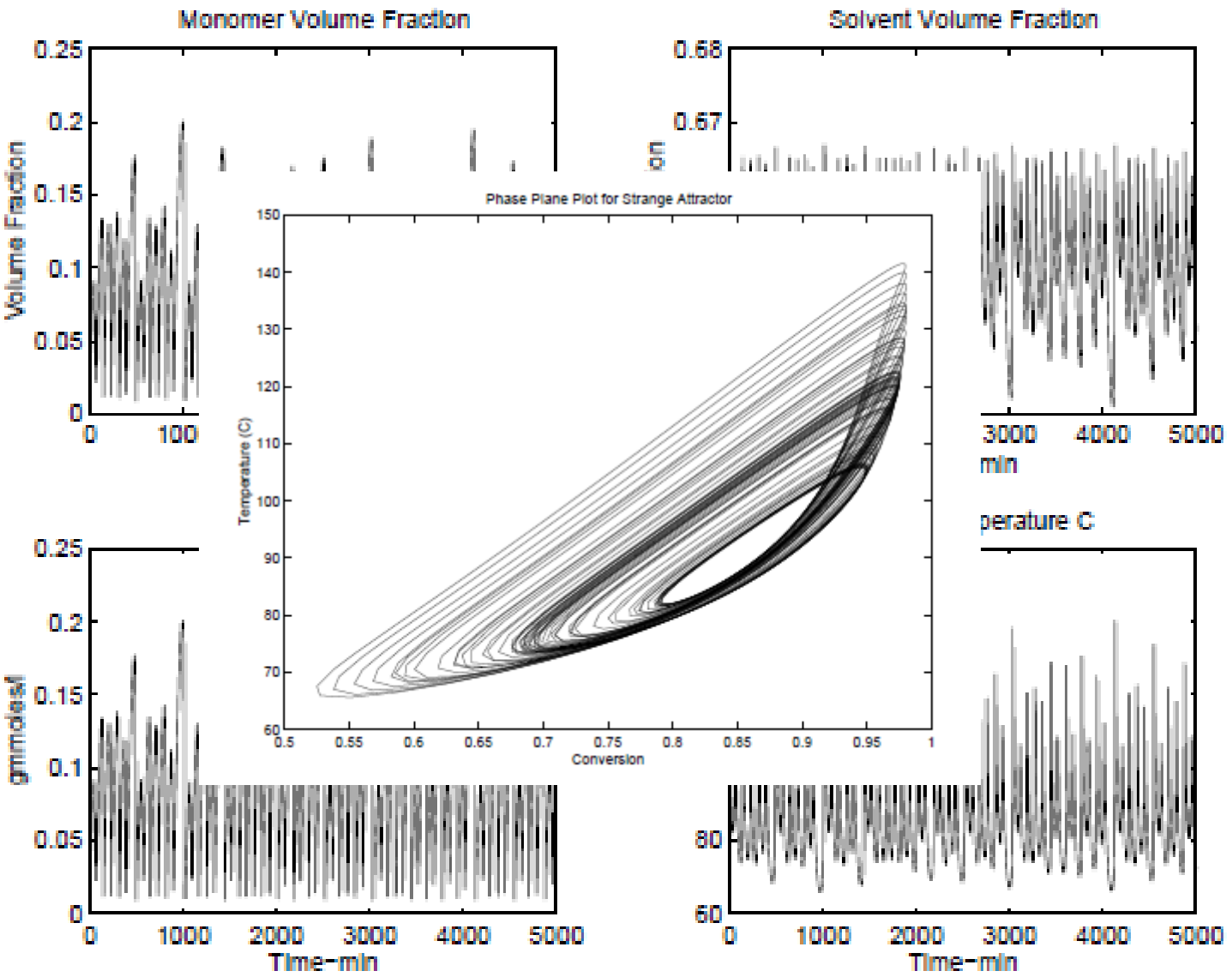

130.
120.
110.
100.
90.
80.
70.
60.
50.
Temperature (°C)
70.
72.
74.
76.
78.
80.
Residence Time (min)


Monomer Volume Fraction
Volume Fraction
Time-min
0
0.05
0.1
0.15
0.2
0
200
400
600
800
1000


Phase Plane Plot for PLP
Temperature (C)
Conversion
60
70
80
90
100
110
120
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1


Initiator Concentration
gmole/l
Time-min
0
0.05
0.1
0.15
0.2
0
200
400
600
800
1000


C
Time-min
60
70
80
90
100
110
0
200
400
600
800
1000


Monomer Volume Fraction
Volume Fraction
0.25
0.2
0.15
0.1
0.05
0
0
100
Solvent Volume Fraction
0.68
0.67
on
3000
4000
5000
min
Phase Plane Plot for Strange Attractor
Temperature (C)
150
140
130
120
110
100
90
80
70
60
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Conversion
perature C
gmmdes
0.25
0.2
0.15
0.1
0.05
0
0
1000
2000
3000
4000
5000
Time-min
80
60
0
1000
2000
3000
4000
5000
Time-min