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ASYMPTOTIC BEHAVIOR OF SOLUTIONS FOR A MATHEMATICAL MODEL ON CHEMICAL INTERFACIAL REACTIONS

Dedicated to Professor Hiroki Tanabe on his sixtieth birthday

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1. Introduction

In the present paper we investigate the asymptotic behavior of solutions for parabolic systems closely related with a chemical interfacial reaction model which is considered in Yamada and Yotsutani [7]. Let I and $\bar{I}$ denote the intervals $(0, 1)$ and $[0, 1]$ respectively. Consider an initial boundary value problem for $u_i=u_i(x, z)$ $(i=1, 2, 3$ and $(x, z)\in\bar{I}\times[0, \infty))$:

$$\text{(P)}\qquad \begin{cases} a_i(x)\dfrac{\partial u_i}{\partial z} = \dfrac{\partial^2 u_i}{\partial x^2}\,, & (x, z)\in I\times(0, \infty)\,, \\ \dfrac{\partial u_i}{\partial x}(0, z) = R_i(u_1(0, z), u_2(0, z), u_3(0, z))\,, & z\in(0, \infty)\,, \\ \dfrac{\partial u_i}{\partial x}(1, z) = 0\,, & z\in(0, \infty)\,, \\ u_i(x, 0) = \phi_i(x)\geq 0\,, & x\in I\,, \end{cases}$$

where $a_i(x)$ $(i=1, 2, 3)$ are given functions, $\phi_i(x)$ $(i=1, 2, 3)$ are given nonnegative initial data and

$$\begin{aligned} R_1(u_1, u_2, u_3) &= k_1 R_0(u_1, u_2, u_3)\,, \\ R_2(u_1, u_2, u_3) &= k_2 R_0(u_1, u_2, u_3)\,, \\ R_3(u_1, u_2, u_3) &= -k_3 R_0(u_1, u_2, u_3)\,, \\ R_0(u_1, u_2, u_3) &= (u_1^{n_1} u_2^{n_2} - u_3^{n_3})\,\beta(u_1, u_2, u_3) \end{aligned}$$

with positive constants $k_i(i=1, 2, 3)$, positive integers $n_i(i=1, 2, 3)$ and a suitable positive function β.

The initial boundary value problem (P) models chemical reactions on interfaces. Such a model has been proposed by Kawano et al. [3]. They put

$$a_i(x) = c_i(1-x^2) \quad (i = 1, 2, 3)\,,$$