2007 Vol.47 No.3 pp.479-486 DOI:

# Kinetic Behavior of Aggregation-Exchange Growth Process with Catalyzed-Birth

HAN An-Jia, CHEN Yu, LIN Zhen-Quan, and KE Jian-Hong

Department of Physics, Wenzhou University, Wenzhou 325027, China
(Received: 2006-6-29; Revised: )

Abstract: We propose an aggregation model of a two-species system to mimic the growth of cities' population and assets, in which irreversible coagulation reactions and exchange reactions occur between any two aggregates of the same species, and the monomer-birth reactions of one species occur by the catalysis of the other species. In the case with population-catalyzed birth of assets, the rate kernel of an asset aggregate $B_k$ of size k grows to become an aggregate $B_{k+1}$ through a monomer-birth catalyzed by a population aggregate $A_j$ of size j is $J(k,j)=Jkj^{\lambda}$. And in mutually catalyzed birth model, the birth rate kernels of population and assets are $H(k,j)=Hkj^{\eta}$ and $J(k,j)=Jkj^{\lambda}$, respectively. The kinetics of the system is investigated based on the mean-field theory. In the model of population-catalyzed birth of assets, the long-time asymptotic behavior of the assets aggregate size distribution obeys the conventional or modified scaling form. In mutually catalyzed birth system, the asymptotic behaviors of population and assets obey the conventional scaling form in the case of $\eta=\lambda=0$, and they obey the modified scaling form in the case of $\eta=0$, $\lambda=1$. In the case of $\eta=\lambda=1$, the total mass of population aggregates and that of asset aggregates both grow much faster than those in population-catalyzed birth of assets model, and they approaches to infinite values in finite time.

PACS: 05.40.-a, 82.20.-w, 68.43.Jk, 89.75.Da
Key words: kinetic behvavior, aggregation-exchange growth, catalyzed-birth, scaling law, rate equations

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