

# PHYSICO-GEOMETRIC KINETICS OF COMPLEX SOLID-STATE REACTIONS

**N. Koga,<sup>1</sup> L.A. Perez-Maqueda,<sup>2</sup> L. Favergeon,<sup>3</sup> N.V. Muravyev,<sup>4</sup> S. Yamada<sup>5</sup>**

<sup>1</sup> Graduate School of Education, Hiroshima University, Higashi-Hiroshima, 739-8524 Japan

<sup>2</sup> Institute of Materials Science, C.S.I.C.-University of Sevilla, 41 092 Sevilla, Spain

<sup>3</sup> Mines Saint-Etienne, Univ Lyon, CNRS, UMR 5307 LGF, Centre SPIN, F-42023 Saint-Etienne, France

<sup>4</sup> Semenov Institute of Chemical Physics, Russian Academy of Sciences, 119991 Moscow, Russia

<sup>5</sup> Department of Applied Chemistry, National Defense Academy of Japan, Yokosuka 239-8686, Japan

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Kinetic analysis of the solid-state reaction using thermal analysis (TA) is the established scientific tool and widely applied to many technological processes [1]. However, many solid-state reactions proceed with complex behavior regulated by heterogeneous characteristics [2]. Rather simple solid-state reactions should be described by considering consecutive physico-geometrical processes such as surface reaction–reaction interface shrinkage and nucleation–growth [3,4]. Further, the surface product layer produced by the reaction regulates diffusion of gases that contribute to the reaction as reactant and product. The mass transfer phenomena influence on the rate behavior and sometimes impede the reaction [5]. Formation of diffusion path in the surface product layer is necessary for the reactivation [6]. As the result, the overall reaction proceeds as the multistep reaction caused by the physico-geometrical constraints. The concurrent or consecutive chemical reactions occurring in the solid-state exhibit more complex kinetic behavior. For these reactions, the comparing reaction steps can indicate differently signed TA signals, i.e., mass loss versus mass gain [7] and exothermic versus endothermic effects [8]. For extending basic kinetic theory and the kinetic calculation methods using TA data to be applicable to the complex solid-state reactions, detailed case studies for the selected reaction processes that exhibit different physico-chemical and physico-geometrical complexities are necessary. In this presentation, the cutting-edge of the kinetic analysis for the complex solid-state reactions is briefly reviewed with special attentions to (i) kinetic deconvolution analysis [9], (ii) induction period–surface reaction–phase boundary controlled reaction model [3,4], and (iii) impact of the evolved gas on the overall kinetics.

## Références

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