

Abnormal nano-sized adsorbate islands growth in a model of adsorptive multilayer system

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We develop previously proposed approach for adsorptive monolayer systems manifesting formation of nano-sized adsorbate/vacancy islands at condensation from a gaseous phase [1]. In this study we propose a generalized model for nano-sized islands growth in substratum-mediated adsorption multilayer systems [2]. It is shown that dynamics of a surface coverage of n mono-layers

$$\vec{c} = \{c_i(\mathbf{r}, t)\}_{i=1}^n, \quad ($$

is the local coverage on i -th layer, $\mathbf{r} = \{x, y\}$) is described by a system

$$c_i(\mathbf{r}, t)$$

of reaction-diffusion type:

$$\partial_t \vec{c} = \vec{f} - \nabla \times \vec{J}$$

chemical reaction terms

$$f_i(\vec{c}(\mathbf{r}, t)) \quad (\text{responsible for adsorption, desorption,}$$

dimers formation, and transfer of adatoms between two neighboring layers) arranged in the vector

$$\vec{f} = \{f_i(\vec{c}(\mathbf{r}, t))\}_{i=1}^n, \quad \text{and the total diffusion flux}$$

$\vec{J} = \{J_i(\vec{c}(\mathbf{r}, t), \nabla)\}_{i=1}^n$, where the diffusion flux on i -th layer

$$J_i(\vec{c}(\mathbf{r}, t), \nabla)$$

takes into account free diffusion of adatoms and rearrangement of interacting adatoms. It is shown that the system manifests cascade of first order transitions related to the number of growing atomic layers. We have found that pattern formation on low layers is governed by a rate of adatom transference between neighboring layers. Critical coverage and critical island size governing adsorbate islands formation are defined. Anomalous dynamics of adsorbate island size growth and a crossover of dynamical regimes are discussed. Distributions of adsorbate/vacancy islands over their sizes are studied in details. It is shown that the linear size of vacancy/adsorbate islands varies from 20 to 100 nm.

1. Kharchenko V., Kharchenko D, Dvornichenko A. Statistical properties of

nanosized clusters on a surface in overdamped stochastic reaction-Cattaneo systems // Surf.Sci.-2014.-**630**.-P. 158-167.

2. *Kharchenko V., Kharchenko D.* Statistical properties of abnormal nano-sized adsorbate islands growth in a model of adsorptive multilayer system // Surf.Sci.-2015.-**637-638**.-P. 90-100.