

ENGINEERING SURFACE STEPS THROUGH SHADOWING

by

Ruoxin Zhang

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

MASTER OF SCIENCE

Major Subject: **MECHANICAL ENGINEERING**

Approved:

Dr. Hanchen Huang, Thesis Adviser

Rensselaer Polytechnic Institute

Troy, New York

December, 2008

ABSTRACT

Surface Steps are critical to numerous engineering processes. They affect or even dictate surface roughness, and are a controlling factor in nanorods synthesis. The surface steps interact with each other, flow during synthesis, and cluster. The result of clustering is step bunching. Both thermodynamic and kinetic factors can lead to step bunching.

This thesis reports the discovery of a mechanism of step bunching. Under glancing angle deposition, there is a preferential deposition flux at steps. This preference affects the rate of step flow, and the effect is more prominent for steps next to shorter terraces. As a result, these steps flow faster in comparison to others next to longer terraces. The difference in flow rates leads to bunching of steps that are at close proximity. This discovery is based on molecular mechanics simulations, and provides a new alternative of engineering surface steps.