UV-FEL PEEM of Silicide Nanostructure Coarsening on Si (001) surfaces

M.C. Zeman[1], R.J. Nemanich[1] , and W.-C. Yang[2*]
[1]*Department of Physics, North Carolina State University, Raleigh, 27695, USA*
[2] *Department of Physics, Dongguk University, Seoul, 100-715, Korea*

We present that real-time observation of coarsening dynamics of nanoscale transition metal silicide ($TiSi_2$, $ZrSi_2$, and $HfSi_2$) islands on Si surfaces. Ultra-violet free electron laser photoelectron emission microscopy (UV-FEL PEEM) is employed for real-time, in situ monitoring of the dynamics and evolution of the nanostructures at high temperatures. Continuous annealing at ~1200^{o}C leads to reduction in the number and increase in the size of the silicide islands on the surfaces due to the late stage coarsening mechanisms of Oswald ripening and attractive migration and coalescence. Attractive migration and coalescence is a new coarsening process where nearby islands are observed to migrate attractively towards each other and subsequently coalesce (fig. 1). This process has been attributed to the growth-decay flow of the island edges driven by a non-uniform chemical potential around the islands. The non-uniform chemical potential is predicted to result in an island shape distortion due to the local flux of adatoms around the edges of the islands. We report the detailed observation of the shape distortion of the islands.

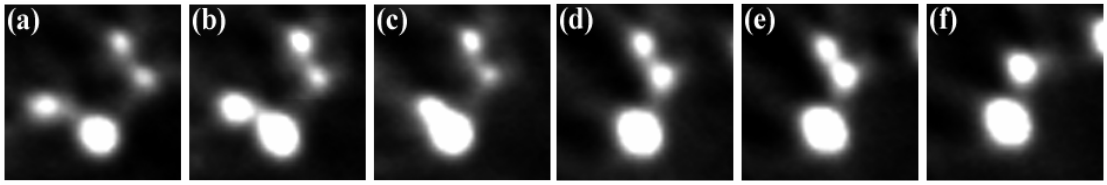

Fig. 1. A sequence of PEEM images showing two pairs of $HfSi_2$ islands exhibiting attractive migration and coalescence on Si(001) during annealing at ~1200^{o}C. Images were obtained as the sample was at 1200^{o}C for (a) 0sec, (b) 100sec, (c) 175sec, (d) 425sec, (e) 595sec, and (f) 705sec, respectively.

* Corresponding Author: Woochul Yang, Department of Physics, Dongguk University, Seoul, 100-715, Korea, Email: wyang@dongguk.edu, Tel: +82-02-2260-3444, Fax: +82-02-2277-3619