Triggering the ring growth by manipulating Pb-islands on Si (111)-(7x7)

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Pb/Si (111) has been the subject of research for almost two decades due to its pronounced quantum well effect and its special growth mode. The diffusion behavior is still not fully understood. One issue with experimental investigation using atomic force microscopy (AFM) is the fast dynamics in this system. Islands grow explosively fast and their growth cannot be imaged [1]. The same applies to the rings that form when an island grows in height. To learn more about island growth and ring formation, we deliberately triggered ring growth by manipulating an island. For this experiment, we evaporate approximately 5 monolayers of Pb onto Si (111) -(7x7). The substrate was cooled to 120 K during evaporation to prevent ring formation on the island. The substrate was then gradually heated to 300 K and the island was manipulated to induce ring growth. For this we used our AFM cantilever to move material on the island via sample contact, causing a local imbalance and prompting the island to form a ring. In addition to non-contact AFM topography measurements, local contact potential differences were measured using Kelvin probe force microscopy (KPFM). We show that we can use this methodology to manipulate islands without imbalancing the global system. We can use it to locally investigate the mass transport behaviour of Pb on a single island. In addition to the intended ring growth, we observed that the island transformed into a hexagon. We also show how the local behaviour of the manipulated island and the global behaviour of the surrounding islands differ.

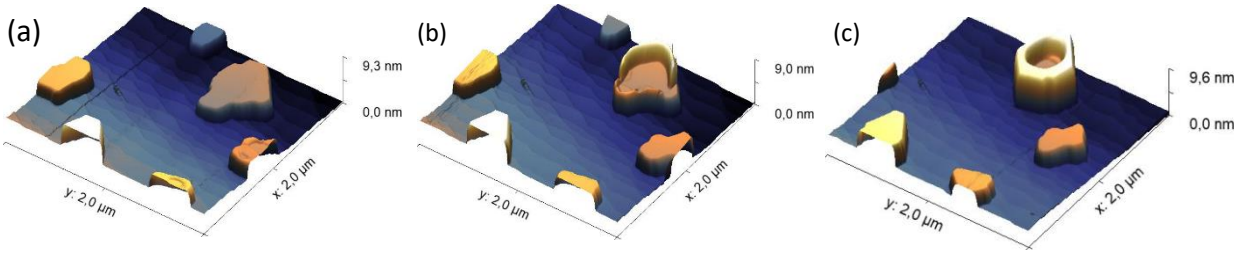

Fig. 1. Topographic images measured by NC-AFM with a super sharp silicon cantilever. (a) shows the initial state before manipulating one Island. (b) is the moment of manipulation. The Ring starts to grow directly after tip-contact. (c) shows the same area 93 min after (b).

[1] M. Hupalo, S. Kremmer, V. Yeh, L. Berbil-Bautista, E. Abram and M. C. Tringides, Surf. Sci. **493**, 526-538 (2014)