

Reply Giesen and Ibach: Although the effect of rapid island decay as such is now well established the mechanism is still in question. On Cu(111) [1] the rapid decay begins at a critical distance w_c of about 1.4 nm, the distance is independent of temperature, and the decay can be quantitatively accounted for with the assumption that the Ehrlich-Schwoebel (ES) barrier vanishes for terrace width below w_c . We have extended our studies to Ag(111) [2]. As in the case of Cu, we find that rapid decay sets in at a distance which is independent of temperature. Fig. 1 shows decay curves of a double layer island at 303 K. Both islands decay, the upper one with a smaller rate of -0.07 atoms/s. As the terrace width between the islands decreases the decay rate increases to -0.53 atoms/s. Then, the terrace width stays constant at about 1.5 nm, save for some scattering. The initial decay is quantitatively described by diffusion limited decay in the presence of an ES-barrier (dashed line, see [1] for details) with the parameters taken from Morgenstern et al [3] and no parameter fitted to this data. The agreement is excellent until the terrace width approaches the critical width of 1.5 nm. If none of the parameters would change the terrace width would drop to zero and the upper island would decay as permitted by the lower island. The rapid final decay is quantitatively described by assuming that the ES-barrier vanishes at $w_c = 1.5$ nm (solid lines in Fig.1) As in the case of Cu, w_c is independent of temperature [2].

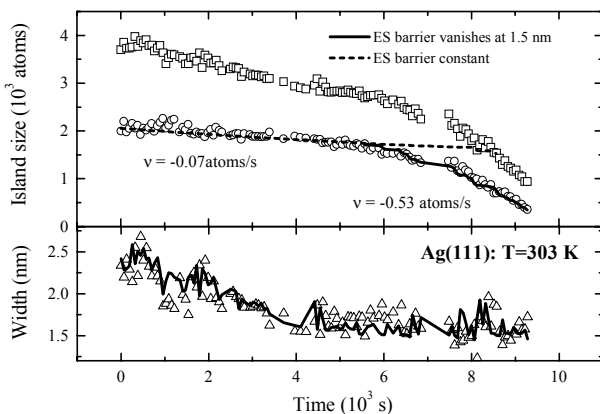


FIG. 1. Island area and terrace width vs. time.

For Cu(111) $w_c = 1.4$ nm is precisely the distance where the occupation of the surface state vanishes because of quantum confinement and we concluded [1] that the existence of an ES barrier is related to the occupation of surface states. Based on that concept we proposed a critical distance for Ag(111). According to [4] w_c should be about 6 nm at 300 K and increase substantially at higher T for Ag(111) [2]. Our data for Ag are incompatible with the proposition that the ES barrier is related to the surface state. Hence, the agreement between the criti-

cal widths for the decay and for the surface state occupation on Cu(111) must be considered as coincidental.

We note the data can also be fitted by assuming that the activation energy for adatom creation and/or for terrace diffusion is reduced at w_c by about 0.1 eV or more. The reduction could extend over a certain distance range. A key feature may be that w_c amounts to the same number of atom rows (six) for Ag(111) and Cu(111). The origin of the rapid decay may be related to the overlap of strain fields arising from the steps and also to a lateral extension of the ES barrier [5]. Strain fields were considered to be responsible for rapid mass transport between vacancy islands on Ni(100) [6].

In their comment Morgenstern et al. report the decay of a vacancy island at 300 K and a rapid decay event at 240 K. The data in their Fig. 1a do not contradict our results. Their conclusion that w_c must be smaller than the distance for electronic confinement is in agreement with our $w_c = 1.5$ nm. We do not agree with the argument that a breakdown of the ES barrier "would merely add an extra sink to already existing sinks". In the absence of an ES barrier, the decay rate is proportional to the inverse of the distance, in the macroscopic description of diffusion limited decay. Since the island considered in Fig. 1b is very close to the step edge the decay rate should become noticeably larger [7]. The quantitative estimate performed by Morgenstern et al. takes the macroscopic theory to the extreme limit of a one atom wide terrace where an atomistic description is required. A process involving an immersion of a kink atom into the step edge of the lower island next to a kink was proposed by N.C. Bartelt in 1997 [8]. While such a process is not relevant to the rapid decay which occurs at larger distances it may well be important at very small distances.

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