Shaping the hilly landscapes of a semi-conductor nanoworld

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Nanoscale worlds sometimes resemble macroscale roller-coaster style hills, placed at the tip of a series of hexagons. Surprisingly, these nanohills stem from the self-organisation of particles - the very particles that have been eroded and subsequently redeposited following the bombardment of semi-conductors with ion beams. Now, a new theoretical study constitutes the first exhaustive investigation of the redeposition effect on the evolution of the roughening and smoothing of two-dimensional surfaces bombarded by multiple ions. The results demonstrate that the redeposition can indeed act as stabilising factor during the creation of the hexagonally arranged dot patterns observed in experiments. These findings by Christian Diddens from the Eindhoven

University of Technology, in the Netherlands, and Stefan Linz, from Munster University, Germany, have been published in a study published in *EPJ B*.

To calculate multiple simulations of redeposition within reasonable computation times, the authors have developed an elaborate new highly efficient algorithm that combines established erosion models with a redeposition model. The latter made it possible to approximate the entire microscopic redeposition dynamics as a function of the relative height and the local slope of a coarse-grained surface. This approach is also supplemented by a new numerical algorithm to calculate precisely how the matter lifted by the ion beams is subsequently redeposited.

This led to the realisation that eroded particles predominantly redeposit in the vicinity of the valleys, whereas almost no particles reattach at the hilltops. Overall, they found that the redeposition mechanism can contribute towards the formation of stable hexagonal patterns. They also confirmed that the aspect ratio of the well-ordered structures resulting from numerical simulation is comparable with experimental findings. This means that the reattachment of eroded particles can play an important role in the observed nanostructures formations. At the same, they comprehensively investigated the distribution of redepositing particles on patterned surfaces.

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