

Direct Observation of the Thermal Decomposition of Ligand-Stabilized Clusters

G. Radu, U. Memmert, H. Zhang, G. Nicolay, F. Reinert, and U. Hartmann

Ligand-stabilized Au₅₅ clusters have been observed by scanning probe microscopy upon thermal decomposition on top of graphite and mica substrates. On highly oriented pyrolytic graphite as well as on mica the ligand shell exhibits a thermal decomposition at a temperature of about 390 K. This temperature well matches data obtained on cluster solutions and pallets. The ligand decomposition results under ultrahigh vacuum conditions in the formation of naked Au clusters. The in situ needle sensor studies show that, due to the high cluster mobility at elevated temperatures, bigger spherical Au aggregates are formed on the graphite substrate. In contrast, on the mica substrate, the naked Au clusters aggregate to form small uniform islands that are stable up to temperatures of more than 700 K. Bigger Au aggregates could only be formed upon pushing the clusters by the microscope's probe at elevated temperatures. The significant difference in the cluster decomposition and aggregation processes on graphite and mica is attributed to the influence of a strong cluster-substrate interaction, which is solely present for mica.