

## Evidence of stable pyramidal Au<sub>20</sub> clusters observed by scanning tunneling microscopy

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Clusters with a closed electronic shell structure and enhanced stability are promising candidates to synthesize new advanced nanomaterials. However, imaging and controlling the structure of individual clusters at the atomic scale remains a major challenge [1]. Very recently, we have realized significant progress to image size-selected gold clusters by scanning tunneling microscopy (STM) [2]. Clusters were deposited on NaCl insulating films with thickness of 2, 3, and 4 monolayers (2L/3L/4L) grown on Au(111) surfaces. While small Au clusters penetrate through 2L NaCl, they are stable on 3L NaCl with a moderate degree of mobility and extremely mobile on 4L NaCl. Based on systematic STM topography and spectroscopy measurements of size-selected Au<sub>10</sub>, Au<sub>20</sub>, and Au<sub>50</sub>, we show that individual size-selected clusters can be retrieved on top of 3L NaCl. Most remarkably, we have observed several individual Au<sub>20</sub> clusters with triangular symmetry consistent with a pyramidal structure similar to Au<sub>20</sub> in the gas phase [3].

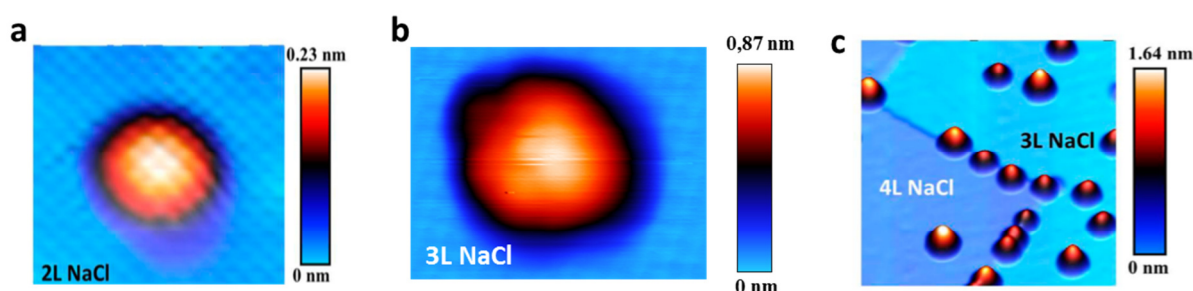


Figure 1, (a) Size-selected Au<sub>20</sub> cluster below 2L NaCl, (b) individual Au<sub>20</sub> cluster on top of 3L NaCl with triangular symmetry, and (c) several clusters on 3L and 4L NaCl including individual and aggregated clusters (Au<sub>20</sub>)<sub>n</sub> with n=1, 2, and 3 as well as clusters located at 3L/4L step edges.

- [1] Z.W. Wang and R.E. Palmer, *Nanoscale* **4**, 4947 (2012)
- [2] Z. Li, H.Y.T. Chen, K. Schouteden, T. Picot, K. Houben, T.W. Liao, C. Van Haesendonck, G. Pacchioni, P. Lievens and E. Janssens, *Nano Letters* **16**, 3063 (2016)
- [3] J. Li, X. Li H.J. Zhai and L.S. Wang, *Science* **299**, 864 (2003)