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Mechanical properties of Au_{55} clusters investigated by NC-AFM — •Georgeta Radu, Dirk Mautes, and Uwe Hartmann — Institute of Experimental Physics, Saarland University, D-66041 Saarbrücken, Germany

In recent years, non-contact atomic force microscopy (NC-AFM) became a powerful tool for imaging at high resolution as well as for probing specific surface properties. In order to investigate the mechanical properties of individual clusters, thin films of ligand-stabilized Au_{55} clusters have been deposited on Au(111) and highly oriented pyrolytic graphite (HOPG) substrates. The NC-AFM images show locally ordered monolayer islands on the Au(111) substrate and disordered ones on the HOPG substrate. Frequency shift- and damping-versus-distance measurements on individual clusters as well as on the bare substrate were performed. The interaction force and dissipated energy were deduced from the experimental curves. Combining the experimental results with theoretical models, the strength and the distance dependence of the interaction force between tip and an individual Au_{55} cluster has been analyzed quantitatively. Furthermore, the individual contributions of the gold core and the ligand shell could be identified in the interaction between tip and an individual Au_{55} cluster. The measured energy dissipation is of the same order as the energy of vibrational modes due to bondstretching in the ligands and between the gold atoms and the ligands. Therefore, the energy is most likely dissipated into vibrations of the ligands through a stochastic dissipation mechanism.

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