Ion-Solid Interactions on the Nanoscale

Graupner, Julia

Due to ongoing technical miniaturization, the importance of nanoparticles in research and application is constantly growing. When bombarding nanoparticles with energetic ions, atoms from the target are ejected; a process called Sputtering. There are theories about sputtering in nanoparticles, but experimental verification is still needed. This project's goal was to fill this gap and thereby contribute to nanomaterial science. The interactions of gallium ions, of varying energies, with gold nanoparticles were examined. With the use of a scanning electron microscope, the nanoparticles were observed while ion bombardment took place. Shape and size of nanoparticles in all resulting pictures were measured using an image analysis program, making it possible to calculate the volume of the particles and the sputteryield for every step of bombardment. Results were compared to existing simulations based on theories about sputtering. As predicted by the simulation, irradiated nanoparticles were shrinking, but the sputteryield was distinctly larger in experimentation than in simulation. Also, a great size and energy dependence of the sputtering process in nanoparticles was noticed. With the found differences between experiment and simulation, existing theories and calculations can be adjusted enabling more precise predictions in the future, supporting further technical miniaturization. The project also opened up new possible applications. The size and shape of nanoparticles can now be tailored for various applications by using measured parameters to control nanoparticle diameter. Also this experiment showed the opportunity to optimize sputter deposition in major industrial processes by using nanoparticles instead of bulk.

Awards Won:

Third Award of $1,000