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On the Shapes and Crystal Structure of Metal Nanoparticles: A New Vision Using Cs CorrectedTEM-STEM

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The study of metal nanoparticles has fascinated scientists in many fields for more than 150 years. Even before the discovery of the atom Faraday introduced the concept of divided metals to describe nanosized chunks of matter. Once that Electron microscope allowed direct observation of nanoparticles produced by evaporation (in the decade of the sixties) it was clear that metal nanoparticles appear many times with shapes not observed in its bulk counterparts. Most notably shapes with five fold symmetry such as the decahedron and the icosahedron were observed. More surprisingly the diffraction patterns reflected five fold symmetry not allowed in bulk crystals. Theoretical studies will suggest that in the size range up to 2 nm the decahedron and the icosahedron are minimum energy configuration but as soon as the size increases the FCC configuration (with steps) becomes the most favorable. However on the experimental side we can observe particles much larger that 2 nm which are still five –fold. In this talk we will discuss the reasons of this behaviour based on TEM and SEM analysis. For many years high resolution TEM was the most powerful tool to study five fold particles. However in the present day, microscopes with spherical aberration correction are now available. Particularly the STEM-HAADF images give detailed information about the atomic positions. We will present atomically resolve images of nanoparticles and compare with theoretical models.