In the talk, I want to present the power of atomic electron microscopy and a promising approach for combining 3D atomic resolution electron microscopy and density functional theory for structure determination of nano-scale interfaces and defects.

By using the spherical aberration corrected transmission electron microscopy and density functional theory calculations, I determined the *three-dimensional* structure of the interface of the Ω precipitate in Al-Cu-Mg-Ag alloy. The determined interfacial atomic structure leads us to further predict growth mechanism of Ω precipitate by extensive density functional theory calculations. The study is also extended to a T1 precipitate in Al-Li-Cu-Mg-Ag alloy system. By using similar approach I demonstrated vacancy mediated nano-sized α phase formation from the ω phase in a beta Ti-Mo alloy which had been known previously as a martensitic phase transformation. I want to also present application of this characterization technique to other nano material systems, for example, individual carbon nanotubes, nanoparticles and oxide thin film interface.