Single crystals of iron with 20, 28 and 40 at. % aluminium were deformed in compression at room temperature. The later two alloys were deformed also at temperatures in the range of yield stress anomaly. Room temperature deformation was carried under the atomic force microscope (AFM) and the evolution of surface was recorded in-situ. Samples deformed at elevated temperatures were investigated by AFM after the deformation. Dislocation structures in deformed samples were then investigated in transmission electron microscope (TEM). Observations of surface (AFM) and bulk (TEM) are compared. Results of both techniques mutually agree and support the interpretation of observed phenomena.

Several original analysis methods were developed. Most notably the stereographic reconstruction, which was applied to dislocation structures and carbide particles present in investigated alloys. Model explaining the distribution of carbide particle axes is presented.