The talk reviews some recent achievements in applying x-ray scattering to the study of the charge and magnetic structure of low dimensional systems.

In a first example the thickness dependence of the geometric structure in pure and cobalt-doped ZnO-film deposited on Ag(111) is discussed. A transition from the bulk Wurtzite (WZ)-type structure to the hexagonal-Boron-nitride (h-BN) phase is observed in the ultra thin film limit. Cobalt doping leads to a phase segregation in which WZ-type CoO-nanoclusters are coherently embedded into the h-BN host ZnO matrix (see Fig. 1). The structure model involving locally confined antiferromagnetic (AF) CoO-clusters supports recent experimental results on the magnetic properties of diluted magnetic semiconductors. The effect of confinement is also decisive for the multiferroic (ferromagnetic/ferroelectric) properties of the BaTiO$_3$/Fe(001) interface. The structure analysis in combination with first principles calculations reveals the onset of polarization at a critical film thickness of two unit cells BaTiO$_3$.

The second part of the talk deals with the analysis of the magnetic structure using soft x-ray resonant scattering. Recent experiments on six mono-layer thick iron films on Cu(001) have led to a new model for the spin structure of this archetype system involving strongly coupled AF spin blocks. The mutual orientation of the spin-blocks can vary easily involving non-collinearity of the spins.