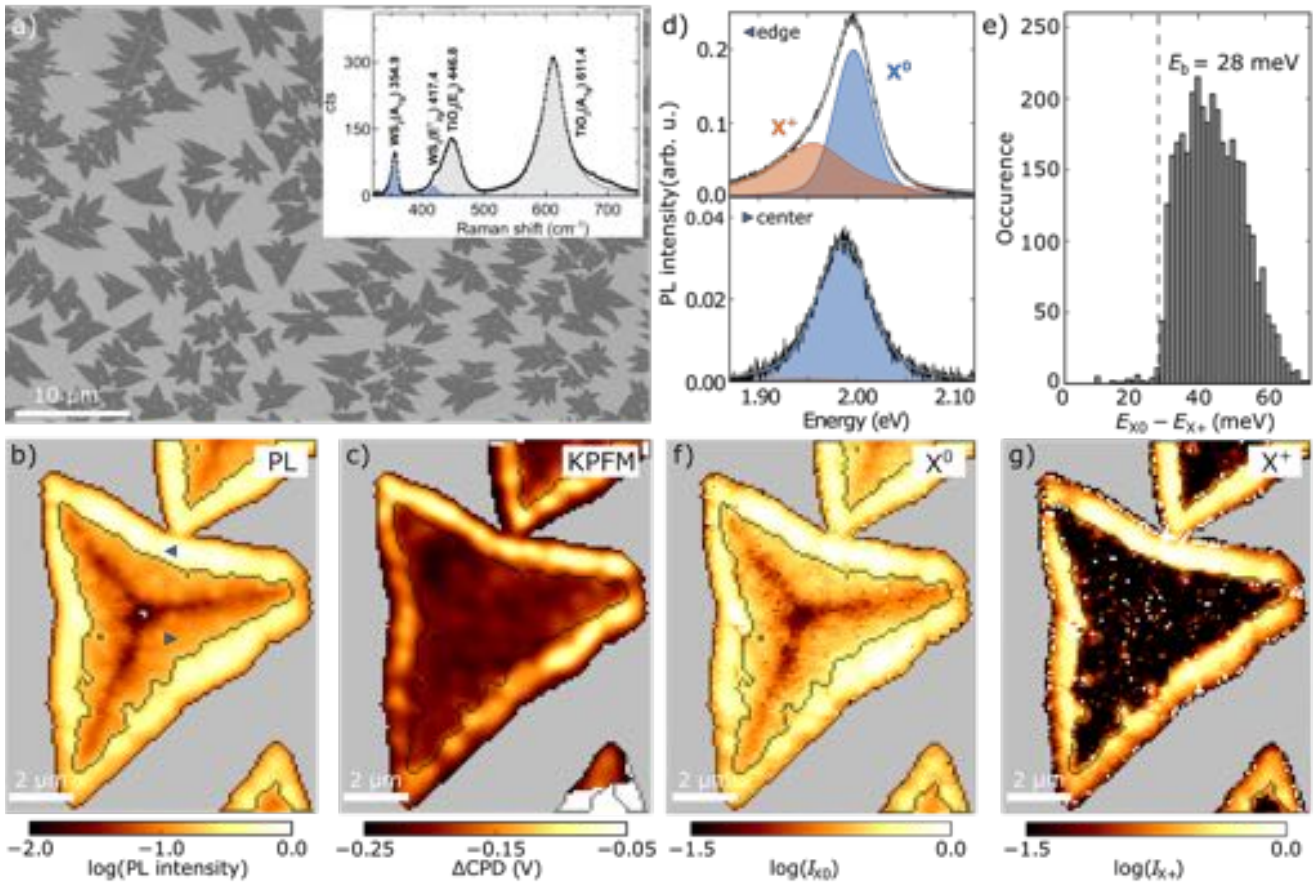

Figure 1. Correlating excitons, trions and surface potential in WS_2 monolayers. (a) Electron microscope image of CVD grown WS_2 (dark) on TiO_2 (light). The inset shows the Raman spectrum of monolayer WS_2. (b) Integrated photoluminescence (PL) intensity of a WS_2 monolayer (log-scale) showing a bright edge region and a dim center region. The black line is guide to eye to separate the edge and center. The gray areas indicate the substrate. **(c)** Contact potential difference map (CPD = ϕ_{sample}-ϕ_{tip}) of the same region as in (b) imaged with Kelvin probe force microscopy (KPFM). The CPD indicates an upwards shift of the bands in the edge region. **(d)** Representative PL spectra from the edge and from the center (triangles in (b)). At the edge, the spectrum is deconvolved into a main peak at X^0 = 1.99 eV (neutral exciton) and a low energy shoulder at X^+ = 1.96 eV (charged trion). At the center, the spectrum is well described by a single peak at X^0 = 1.98 eV. **(e)** Histogram of X^0-X^+. The cut-off of the histogram at 28 meV (dashed line) coincides with the trion binding energy in WS_2. **(f)- (g)** Spatial maps of **(f)** exciton emission intensity I_{X0} and **(g)** trion emission intensity I_{X+}.