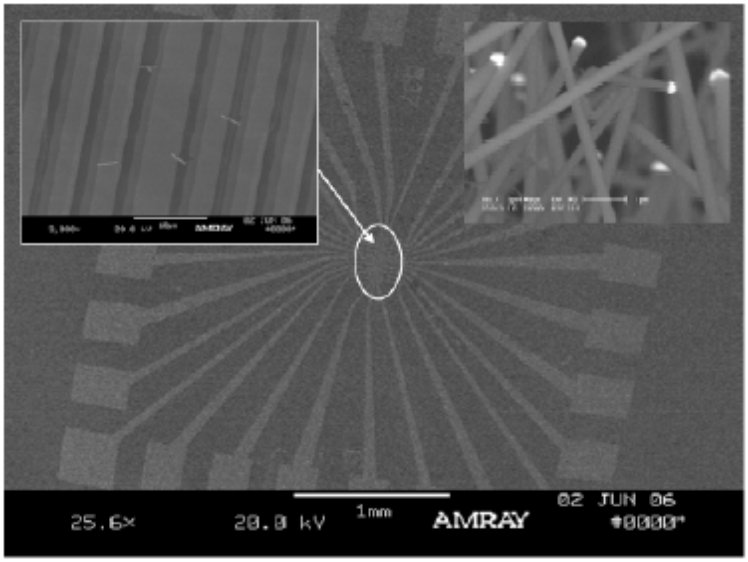
2-D Electron Gas Piezoelectric Sensors (DoD, ARL-ARO)

Exploratory studies on the piezoresistance of 2D electrons confined to AlAs quantum wells have found that transport in the 2D electron gas system displays exceptionally large changes in piezoelectric resistivity. These changes result from strain-induced charge transfer between valley states in the AlAs 2DEG, which have very different effective masses in the direction of current flow. The change in resistance is quite fast and is surprisingly sensitive to the electron density. Gauge factors as large as 12,000 (at B=0) to 60,000 (at B=3 Tesla) have been measured. These values are several orders of magnitude larger than the values obtained in bulk semiconductors, which are typically between values of k=100-500. This discovery should prove to be a very powerful means of enhancing strain sensitivity in these systems, and should lead to extremely sensitive strain sensors in the future.



Electron-beam lithographically patterned metal electrodes as fabricated in the lab, onto which semiconductor-ferroelectric coreshell nanowires (upper right inset) have been deposited using dielectrophoresis.

O. Gunawan, T. Gokmen, Y.P. Shkolnikov, E.P. De Poortere, and M. Shayegan, "Anomalous Giant Piezoresistance in AlAs Two-dimensional Electrons with Antidot Lattices," *Phys. Rev. Lett.* 100, 036602 (2008).