Two-dimensional hole systems in InSb and In$_x$Ga$_{1-x}$As quantum wells

CHOMANI GASPE, MADHAVIE EDIRISOORIYA, TETSUYA MISHIMA, MICHAEL SANTOS, University of Oklahoma — CMOS circuits require $p$-type transistors with high hole mobility, in addition to $n$-type transistors with high electron mobility. In zinc-blende semiconductors, a narrower band gap leads to smaller effective masses for electrons and holes. We have achieved room-temperature electron mobilities of 10,000 and 40,000 cm$^2$/Vs in quantum wells made of In$_{0.53}$Ga$_{0.47}$As and InSb, respectively. To achieve high hole mobilities, strain and confinement must be maximized. Both parameters increase the energy splitting between holes with light in-plane mass and those with heavy in-plane mass. We have observed a room-temperature hole mobility of 600 cm$^2$/Vs in InSb quantum wells with remotely Be-doped Al$_x$In$_{1-x}$Sb barriers grown on GaAs substrates by molecular beam epitaxy. We will discuss the effects of strain, structural parameters, and defect density on hole mobility in InSb and In$_x$Ga$_{1-x}$As quantum wells.