SUPPLEMENTARY INFORMATION

GaAs core nanowires were grown in a low-pressure (100mbar) metalorganic vapour phase epitaxy (MOVPE) system using Au particles, following the particle assisted growth mode. The pattern of Au particles was defined using nanoimprint lithography with a wire to wire distance of 500nm and initial particle diameter of 180nm. The GaAs core was grown at 550°C using TMGa, AsH₃ and TESn with molar flows $\chi_{\text{TMGa}} = 4.3 \times 10^{-5}$, $\chi_{\text{AsH}_3} = 7.7 \times 10^{-5}$ and $\chi_{\text{TESn}} = 4.3 \times 10^{-7}$. The samples on which the core nanowires had been grown were removed from the growth chamber and the Au seed particles were etched down using a KCN-based Au etch to control axial growth during the subsequent shell growth. The GaAs core nanowires were reinserted into the MOVPE system and after an annealing step at 650°C in AsH₃/H₂ atmosphere, a GaInP shell was grown for 5min at 600°C by simultaneously switching AsH₃ to PH₃ and introducing TMGa and TMIn. The molar fractions for the shell growth was $\chi_{\text{PH}_3} = 1.5 \times 10^{-2}$, $\chi_{\text{TMGa}} = 12 \times 10^{-6}$ and $\chi_{\text{TMIn}} = 8.2 \times 10^{-6}$. 