Nanotech in comms

- Source
  - IEEE Comms, June 2010
  - Papers
    - General section intro
    - Nanoscale materials and devices for future comms networks
      - Authors
        - M Saif Islam and Logeeswaran VJ
        - University of California, Davis
- Nanotech
  - Defn
    - Multidisciplinary
      - performance based on
        - physical
        - electronics
        - chemical
        - biochemical
    - Materials/ structures at nano-scale
      - 1 to 100nm
    - Tunable
- Promise
  - Economic impact of nanomaterials and devices
  - comparable to telecoms in 1990s
- Challenges
  - considerable
    - device perf sensitivity
    - fabrication
      - techniques for mass production
- Some general areas of research
  - Interconnect
    - comms networks
    - 3D die stacking
  - sensors
  - photonics
  - RF
  - Wireless
  - nano-energy generation
- Nanomaterials for comms devices
  - issues
    - Copper links reaching limits at speeds of 10Gbps
    - Optical interconnect shows promise
      - But issue of distinct exotic materials
      - The ideal
        - Monolithic integration approaches
  - Research approaches
    - single crystal
      - various semiconductor nanostructures
    - amorphous materials
      - low cost semiconductor and photonics on one structure
      - Could dwarf silicon photonics
    - Nano-heteroepitaxy
      - A technique that can grow a planar epitaxial thin film semiconductor on another single crystal substrate while accommodating mismatches
      - Examples
        - III-V nanowires with >8% lattice mismatch
        - InP nanowires on silicon substrates
        - Still lab work
  - Out of plane optical interconnect
    - Optical devices and waveguides >> electronics components
      - 1000x larger in size
    - To reduce this gap
      - photonic crystals
        - theoretical size of wavelengths 1 micron
      - Ultimately
        - surface plasmon polaritons
          - potential for photonic integration beyond diffraction limit of light
  - Future nanophotonic comms
    - computer design
      - single core to multi-core
      - Now Input/Output becoming a bottleneck
      - potential for ultra
        - high
          - throughput
        - Low
          - latencies and power
      - nano-photonics
        - Power consumption of interconnects
          - few mm of electrical signalling
            - 10pJ/b
          - Optical
            - 100fJ/b --> 10fJ/b
- nanosensors for intelligence everywhere
- Nanomaterials in computing
  - Memristors
  - DNA electronics
  - Carbon-based nanomaterials