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DISORDERED SUPERSTRUCTURES

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Abstract - Semiconductor fabrication schemes such as MBE and MOCVD offer the opportunity to grow layered semiconductors with disorder that is partially or fully controlled. We shall discuss a number of cases for potential study.

(1) Random superstructures. For these structures, one grows layers of, say, GaAs/Al_xGa_1-xAs, whose thicknesses, compositions, or doping are deliberately controlled by a random number generator, and so are reproducibly random. Varying the thicknesses causes the energies and inter-well tunnelling matrix elements of quantum-well electronic states to vary; varying the compositions changes primarily the inter-well matrix elements; and altering the doping produces random electric microfields. An interesting feature of random superstructures is that they are finite in extent, and offer the possibility of studying the onset of electronic localization as a function of size. The possibility of growing semiconductors that are realistically described by Anderson's model of disorder (or variant's of Anderson's model) will be discussed. Predictions of the effects of the disorder on the electronic density of states will be given.

(2) Microscopic randomness. On a microscopic (5Å) scale electronic states are insensitive to disorder because they are "amalgamated", but phonon...
states are disorder-sensitive for virtually all of the semiconductors. We shall present predictions of phonon spectral densities for bulk semiconducting alloys, both stable and metastable; and, provided our research goes well during the period between submission of this abstract and the conference, we shall present results for alloy superlattices.