Superconductivity from two dimensional interfaces: CuCl/Si, GaP/Si, ZnS/Si

S.H. RHIM, R. SANIZ, A. J. FREEMAN, Northwestern University — Two-dimensional (2D) interfaces of hetero-bonded semiconductor superlattices are studied using the highly precise FLAPW method. The 2D system, of metal-insulator-metal, is one of the candidate geometries to realize the excitonic mechanism of superconductivity, where $T_C$ can be greatly enhanced over phonon mediation. Epitaxially grown CuCl on Si (111) was reported to exhibit an anomalous diamagnetic susceptibility at 60~150 K. For all superlattices, 2D metallicity was found at the interfaces due to charge transfer from the polarity mismatch, as evidenced by their bands, Fermi surfaces, and charge densities. The $T_C$, calculated within the crude RMTA and the McMillan-Hopfield formula, is 0.04~4.4K for the CuCl/Si case, but vanishes for the other cases. To pursue the excitonic mechanism, we are determining the Kernel function $K(\omega)$, i.e. the average of the effective Coulomb interaction, with $q$ dependent dynamic screening. First results for CuCl/Si show $K(\omega)$ to be attractive for a certain energy range.

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S. H. Rhim
Northwestern University

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