

Oxides and interfaces in the search for high-temperature superconductivity*

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Abstract

The search for higher critical temperature superconductors has often led researchers to try to find materials presenting conditions for alternative pairing mechanisms. In this presentation, we analyze first-principles density functional calculations of the electronic structures of two such systems, and discuss their bearing upon superconductivity: (i) We first consider the so-called beta-pyrochlore Os oxides (AOs_2O_6 , A=alkali metal), which are claimed to be “unconventional” superconductors by some researchers[1]. (ii) Then we focus on the CuCl/Si(111) interfacial system, which many years ago was found to show signs of a nearly ideal diamagnetic response between 60 K and 180 K[2], and was presented as a possible candidate for excitonic superconductivity. In case (i), our studies show that the observed trends regarding T_c , upon substitution of the alkali metal and under applied hydrostatic pressure, can be understood within a phonon-mediated picture with important contributions from spin fluctuations. In case (ii), we find, interestingly, that the system is metallic at the interface with a strong two-dimensional character. However, if indeed there is high-temperature superconductivity, our estimates of T_c (< 2 K) based on electron-phonon coupling theory show that the phonon-mediated pairing mechanism alone would be too weak to account for it.

[1] T. Muramatsu et al., cond-mat/0502490.

[2] B. L. Mattes and C. L. Foiles, Physica 135B, 139 (1985).

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