"Giant" strengthening of superconducting pairing in small metallic nanoparticles and large enhancement of T_c

Vladimir Kresin
Lawrence Berkeley Laboratory, University of California at Berkeley , CA 94720 *

The discovery of high T_c cuprates has resulted in an intensive search for new superconducting systems. We focus on small nanoclusters ($N \approx 10^2$-10^3 ; N is a number of free carriers) which contain delocalized electrons. These electrons form shells similar to those in atoms or nuclei. It turns out that under special, but perfectly realistic conditions the superconducting pairing is very strong and this leads to high values of T_c It is shown that for realistic sets of parameters one can observe high value of T_c ($T_c \gtrsim 10^2$ K) as well as a strong modification of the energy spectrum . In principle, it is possible to raise T_c up to room temperature. One can propose specific experiments aimed at detecting the phenomenon. Recent heat capacity measurements provide a strong support for the theory. The effect is promising for the creation superconducting tunneling networks. Josephson current through such a network can be greatly enhanced relative to its conventional value.

The theory can be applied to study some aspects of the "pseudogap" state in the cuprates.

* jointly with Y. Ovchinnikov, L.Landau Institute for Theoretical Physics