

transitions take place at $x=0.15$ and at $x=0.23$. Due to the different Fermi surface topology for n-type cuprates we have found only one quantum critical concentration, $x=0.2$. The calculated doping dependence of the nodal Fermi velocity and the effective mass are in good agreement with the recent experimental data.

**Electronic structure of $Ce_nM_mMn_{2m+3n}$ where $n=1, 2$; $m=0, 1$; $M=Co, Rh$ or Ir :
Experiment and Calculations.**

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We present a detailed study of the electronic structure of $Ce_nM_mIn_{2m+3n}$ ($M = Co, Rh, Ir$; $n=1, 2$ and $m=0, 1$) series of Ce-intermetallic compounds. The ground state of these heavy-fermion (HF) materials can be tuned between antiferromagnetism (AF) and superconductivity (SC) with pressure or doping as the tuning parameter.

We perform the x-ray photoelectron spectroscopy (XPS) measurements on the Ce-3d core levels as well as on the valence-band states to analyze the dependence of both the Ce 4f band character and physical properties on the kind of transition metal atom M and on the number of $CeIn_3$ layers intervened by the MIn_2 layer in the investigated family of compounds.

Basing on the Ce 3d XPS spectra we have found that the hybridization energy Δ between 4f and conduction electron states is rather strong for $CeMIn_5$ and Ce_2MIn_8 compounds ($\Delta \sim 90$ meV). The hybridization is slightly stronger for systems with Co and Ir than for their AF counterparts with Rh, which suggests that the character of Ce 4f states is more delocalized in the nonmagnetic compounds. The XPS valence band spectra we compare with ab initio band structure calculations. We present also the comparative study of the valence charge density distribution for the whole family of compounds. We have found that the Ce 4f-electrons participate in bonding charge accumulations for all investigated compounds. Our investigations indicate that the observed changes in the 4f-band onsite hybridization energy results from the reconstruction of the charge density distribution driven by transition metal atoms inserted into the $CeIn_3$ structure.

Basing on the comparative study of the XPS spectra and band structure results, as well as on the charge density analysis we have attributed the variation in properties observed within the both subfamilies mainly to the changes in charge density contributing to the bondings between the NN Ce, M and In atoms. The presented results support the common picture that in the HF f-electron systems the transition to the HF liquid state or the appearance of SC state is connected with delocalization of the f states, as suggested previously.

The Effects of Carbon Nano Filaments (CNT & CNF) Doping on High Temperature Superconductors Y-123

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This paper is based on the effects of carbon nano filaments (carbon nano tubes and carbon nano fibers) doping on Y-123 studies. We synthesized Y-123 with different contents of CNT and CNF doping. The samples were prepared from powders of Y_2O_3 , $BaCO_3$ and

CuO by the solid state reaction. After calcinations in air, we mixed Y-123 powder with different percentage of carbon nano filaments weight, produced by the CVD method.

For obtaining more homogenous mixing, we have suspended it in an organic solvent with an ultrasonic mixer to prevent agglomeration of CNT. The CNT-Y123 powder was dried afterwards, and pressed as pellet samples, in about 1mm thick, 10mm diameter, and 1gr weight, and sintered in oxygen atmosphere. We tried to find the transport effects on CNT and CNF doping in 123 systems. The strong coupling between grains in CNT doped samples caused the flow of inter-granular currents. Therefore the presence of CNT in high temperature superconductor samples increases the critical current density. Among various carbon precursors, carbon nano tubes (CNT) are very interesting because of their nano meter diameter which may make them as effective pinning centers, compared to the ordinary carbon. The carbon nano tubes are functioning like columnar defects produced by heavy-ion irradiation. Nano phase particles or aggregates embodied in the superconductor matrix can pin the flux lines effectively and enhance the intra-grain transport critical current density in high applied magnetic fields. Nano phase size particles in the size range of about 5-10 nm can be used as flux pinning centers for low field applications.

The effects of carbon and carbon dioxide in Y-123 were studied by several groups, but none of them argued the effects of carbon nano tubes doping on Y-123. Uno et al. found that J_c was related to the carbon concentration, but they showed that T_c value and other physical properties did not change. In carbon doped Y123 samples, T_c decreases with carbon content increasing. Also increasing of carbon in samples over 0.06wt%, decreases T_c and less than 0.06wt% carbon content has no effect on T_c . According to our experiments, we obtained changes in critical temperature T_c , by changing CNT doping in Y123 samples (0.1- 1 wt%), with optimum in 0.3wt%. Increasing CNT over that amount decreases T_c . In addition, we prepared samples with different carbon percentage (0.05-1 wt%), and found that superconductivity disappears in materials containing more than 0.5wt% carbon. Carbon increasing in Y123 samples decreases the critical current density (J_c). In this experience, J_c in embedded CNT-Y123 samples was increasing in compare to pure ones. Carbon nano tubes with proper geometry (diameter and its length) could connect the grains of YBCO causing to increase J_c . The CNT's are expected to act as efficient pinning centers in HTSC materials.

In summary, we have prepared high-quality bulk samples of both pure and CNF-Y123. The samples have a sharp superconducting transition from 90 up to 94 K, depending on different weight of CNF doping, which have had optimum T_c in 0.3wt%. Besides, increasing amount of CNT doping increases the critical current density J_c .

Electric field gradients in PrBa₂Cu₃O₇: suppression of (super)conductivity by mis-substitution

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Since the early years of discovery the high-temperature superconductivity, the most prepared PrBa₂Cu₃O₇ (Pr123) samples have shown non(super)conducting behavior in contrast to RBa₂Cu₃O₇ (R=Y or a rare earth element) samples (R123). However, (super)conductivity in some Pr123 samples has recently been reported by some groups. Some people argue that some mis-substitutions (mainly Pr on Ba site (PrBa)) suppress the intrinsic (super)conductivity in pure Pr123. In spite of it, the intrinsic (super)conductivity of Pr123 has not been accepted, yet.