MAGNETIC-ELECTRONIC PHASE DIAGRAM OF Ca DOPED $NdBaCo_2O_{5.5}$

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9.7 cm

RBaCo$_2$O$_{5.5}$ (R=rare earth and Y) undergoes a sequence of magnetic and electronic transitions between antiferromagnetic/ferrimagnetic/paramagnetic and paramagnetic insulating/metallic states with respective transition temperatures T_{N}(∼230-260 K)≤ T_{C}(∼250-290 K)≤ T_{MI}(∼360 K). We have synthesized a Nd$_{1-x}$Ca$_x$BaCo$_2$O$_{5.5}$ series ($0 \leq x \leq 0.2$) of cation ordered [(Nd,Ca)/Ba] and oxygen vacancy ordered materials and investigated them by neutron diffraction, magnetization, electronic and thermal transport. Unlike previously studied materials with hole doping created by adding oxygen, the Ca doping does not disrupt the cation and oxygen vacancy orderings up to $x = 0.20$. We have observed that upon Ca doping T_{N} rapidly decreases to 0 for $x = 0.1$ and T_{C} increases and coincides with T_{MI} for $x \geq 0.12$, which slowly decreases with Ca substitution from ∼360 to ∼340 K. The enhancement of T_{C} to 340 K is the largest ever observed for these cobaltites. We will present magnetic-electronic phase diagram as a function of hole doping that indicates that competition between various phases leads to transition from ferromagnetic below T_{MI} to antiferromagnetic phase above T_{MI} for $x \geq 0.12$.
Work at NIU was supported by the NSF (DMR-0706610) and at ANL by the U.S. DOE under contract No. DE-AC02-06CH11357.

13.4 cm

Subject category :

1. Strongly Correlated Electrons and High Temperature Superconductivity

Presentation mode :
oral

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